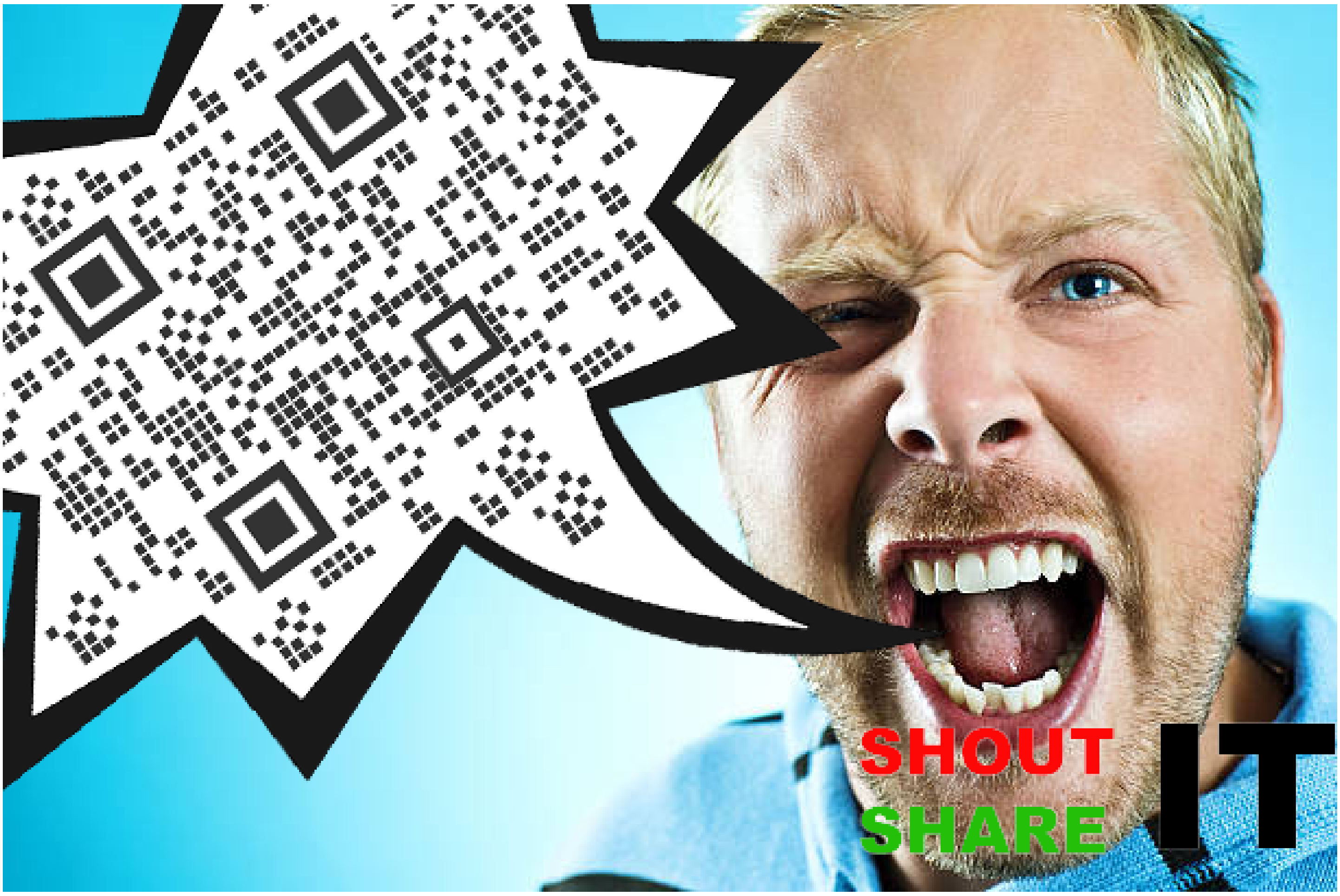
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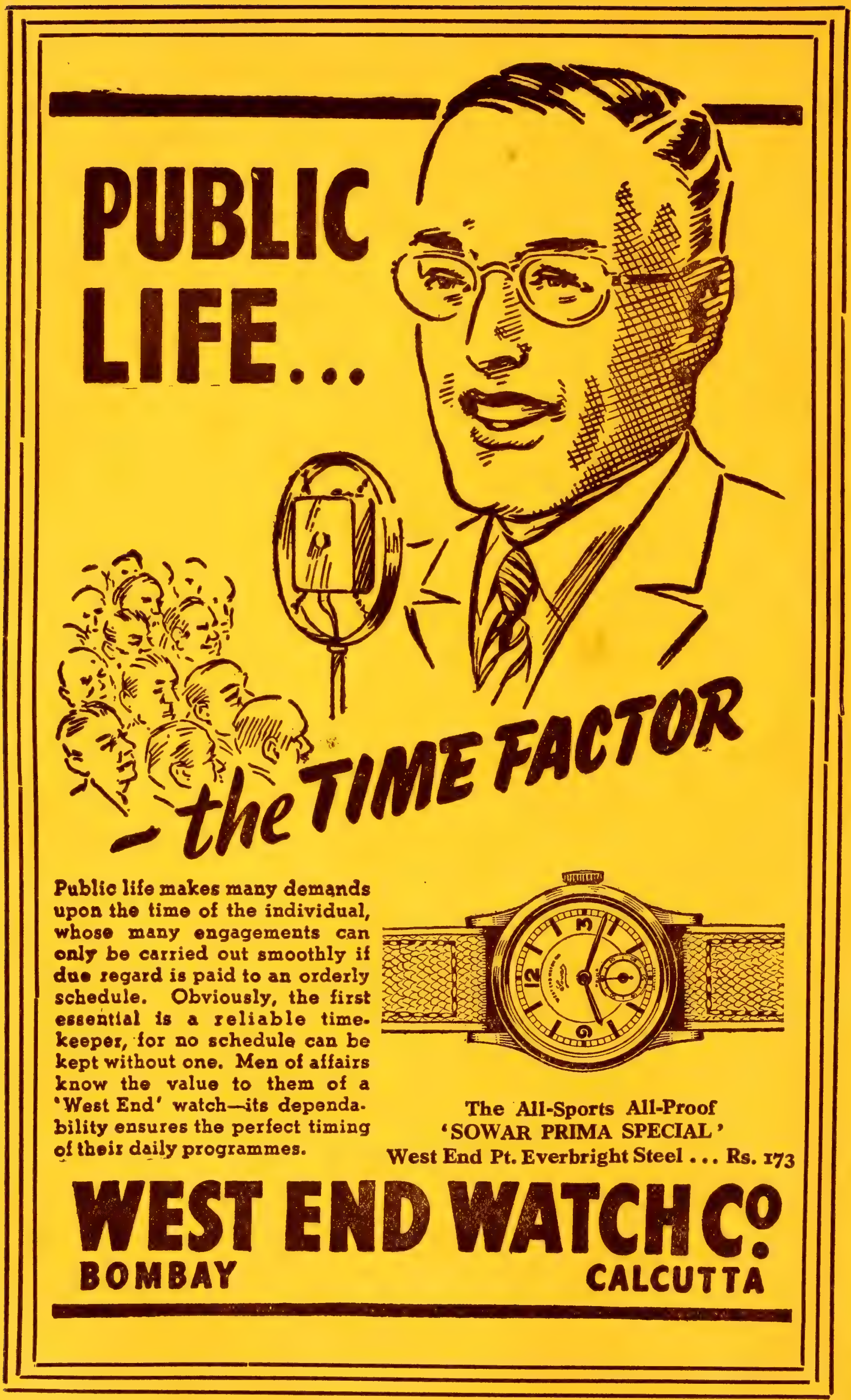

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JUNGLE MEMORIES

BY

LT.-COL. E. G. PHYTHIAN-ADAMS, O.B.E., F.Z.S., I.A. (Retired).

PART IX—ANTELOPE AND DEER

(With two plates)

(Continued from p. 607 *of Volume* 49)

BLACKBUCK

'The Black-buck' says Aflalo in *The Sportsman's Book for India*, 'deserves the premier place both from his numbers and his ubiquity, and we might add, his beauty. He is a never ending source of interest and excitement to the subaltern, and the pursuit of him supplies a perennial and perfectly excellent school for the exercise of his ingenuity, patience and marksmanship.' To which one might also add that this form of shikar never seems to pall, and though I seldom fire a rifle nowadays I find that the sight of a good head impels me to do my best to outwit him. But I must confess that my memories of this elusive animal are as hard to recapture as it is to bring him to bag, largely I suppose owing to the fact that they are (or at any rate used to be) so common, and that one's recollections are therefore less vivid as compared with the pursuit of nobler game. Not that I would for a moment depreciate the Blackbuck, for a really fine head makes a grand trophy and the difficulty of securing it adds to its value. Still, the fact remains that it is hard to remember details of individual stalks, for my diaries are concerned more with regular shikar trips than with outings of a day or two. However, as is only natural, I do remember my first buck which was bagged near Kamptee so far back as 1906. A good friend on the Railway used to take me and another subaltern down the line in his trolley when he was on inspection duty, for any chances of shikar which might offer. On one of these occasions we sighted a herd with a good head some 600 yards away, and as it was my turn for a shot I went after it. A convenient nullah afforded a good line of approach so I slipped off while the trolley continued its course to divert the attention of the buck. The nullah though winding gave good cover, and a final crawl over the open to some convenient bushes brought me within easy shot. The head was only 19½ inches, nothing to be compared with those obtainable in Central India, but it was my first and was prized accordingly.

Having broken the ice I managed to secure several more heads on subsequent occasions but buck were not common in that part, and it was not till I marched with my regiment some months later from Kamptee to Poona, a matter of some 450 miles, that I met them in any numbers. While we were passing through the Berars they were so plentiful that seldom a day elapsed without my bagging one or more for the officer's mess and for the men. But even venison palls, and I remember that my C.O. at last told me as Mess Secretary that a change of diet would be appreciated. As it happened I had shot a nice young buck that morning and when it appeared at dinner that night suitably disguised, all admitted that the *mutton* chops were the best they had ever tasted! What grand days those were. Everything was so well organised that it went like clockwork. The Mess tent was struck after dinner and sent on overnight to the next camping ground, accompanied part of the way by the coffee-shop for officers and men. *Reveillee* sounded at dawn and within an hour all the remaining tents had been struck and packed, and the regiment paraded ready to march off. I, as acting Quartermaster, had to ride on ahead to mark out the new camp and to check over the supplies provided by the civil authorities. The marches averaged 13 miles, though I remember one of only 4 when the whole regiment had to turn on to getting the carts through the deep sand of the Godavari river. That day I certainly had my hands full, but generally I had ample time to do a little scouting within a few miles of camp before the regiment arrived, with a view to shikar in the afternoon. We were, I believe, the first to march that way for upwards of 100 years and any amount of small game was available besides buck. I remember that one day the Deputy Commissioner camped alongside us. He told me that not long before while stalking a buck he had come across a party of no less than five cheetahs engaged in the same quest. I do not suppose there are any hunting leopards left in those parts now, and indeed it is doubtful whether they are to be found in a wild state anywhere in India.

My best memory is of an enormous herd of buck numbering many hundreds near Basim. With some difficulty, owing to the number of watchful eyes, I had managed to work up to a good buck, but when I fired he bolted 50 yards into a small patch of scrub from which I saw him emerge on the far side and gallop off evidently untouched. Rather disgruntled, and finding little consolation in the old saying that all hits are history and all misses mystery, I was starting back for camp when a villager working not far away called out to enquire whether I did not want the buck I had shot. Investigation showed the original animal lying dead in the bushes, shot through the heart. As he fell at the end of his final spurt he must have put up another whose departure I had viewed with such mixed feelings. All of which shows as the monkey said, that things are not always what they seem! The number of buck all over the Berars in those days was incredible, but a friend who came the same way only 15 years later told me that in the meantime they had been practically exterminated in most parts, owing to lack of control over the issue of weapon permits and the absence of any official effort to preserve wild life. I have never seen an albino buck outside a zoo, but when passing through Ahmednagar on that march I heard of a well-known one said to be with a particoloured herd—however I had no time to go after it. Round a large military station like Poona buck were naturally scarce, but even so they were obtainable near Lonikhand not many miles out along the Sirur road. My best heads, which I still have, were obtained at Yewat some way down the line. I had a very pleasant Christmas camp there in 1910 with my shikari Diwaji and enjoyed some excellent small game shooting as well. The next blackbuck I shot was at the foot of the northern slopes of the Nilgiris many years later after I had retired, but the heads there are poor, and in fact the whole animal is noticeably smaller than those in the Deccan and further north. My last was shot in the Bellary district while on tour during the recent war. There are still a fair number there as also in certain parts of Mysore State.

Blackbuck horns are measured straight (and not following the curves as with a deer's antlers) and it takes a good deal of practice to judge whether a head is a good one or not. If it seems disproportionately larger to the size of the animal than it certainly is, but any may be considered shootable whose colouration is notably black and white. In the South a 20-incher is definitely good. The handsomest trophies are those heads with the tips of the horns wide enough apart to form an equilateral triangle. Blackbuck are generally found on cultivated land, and it is well to remember that a bullet from a high velocity rifle carries a very very long way, and may find a billet in some unfortunate villager far beyond. A story was current many years ago of a sportsman who had in this way killed a man, and the shikari suggested concealing the body down a well, assuring his master that no one else had seen the accident. Whereupon the sportsman promptly shot the shikari also and then disposed of both bodies. A very old chestnut, but so antique that it may bear repeating. When after buck it is as well to take a local man with you as he will know not only where they are to be found at different hours of the day, but also where his fellow villagers are likely to be working. Even so it is desirable to use the slope of the ground so far as possible to act as a stop butt to the bullet. There is only one sporting way of bringing a buck to bag, and that is by a fair stalk. Shooting them from a car or from a bullock cart is sheer laziness and definitely not sport. One can learn a lot too when stalking, for even in broken country it is far from easy to get within the close range which is always so desirable in any form of shikar. Blackbuck meat, it may be added, is excellent.

CHINKARA

My experience with these sporting little gazelles is limited, as they are far scarcer than buck, at any rate in the Deccan and South India. My first was one of those lucky chances which befall all shikaris at times, in fact it was a lucky day altogether. For it was on the way back, after shooting my first tiger that I suddenly spotted a chinkara staring at us in the light scrub jungle not 40 yards away. As the tonga passed a good-sized bush I jumped out and from its cover got an easy shot. The bullet caught the chink on the point of the shoulder and apparently exploded there—it was a .400 Jeffery softnose with a lot of lead showing. A patch of skin the size of a small plate had completely disappeared, and no part of the bullet appeared to have penetrated, but the animal was knocked over stone dead. I have had an exactly similar experience with a barking deer.

I do not remember shooting more than one or two chinkara on the march from Kamptee, owing no doubt to the country being more suited to blackbuck, but after arrival at Poona I soon discovered that they were not uncommon in the vicinity of Lonikhand hill, and often went after them at week-ends. I found them far more difficult to bring to bag than buck, though one would expect the converse to be the case, as the broken ground they inhabit seems to offer such easy means of approach. But the chinkara is extremely wideawake, and often when I have reached a spot from which a close shot should have been certain, I found that the herd had moved and was still out of range. Since those days the only chinkara I have seen were in Las Bela while I was after oorial. I did not go after them seriously and so never got one, a fact which I now regret as I believe they are the Persian variety of gazelle. A few are said to exist in Mysore State and in North Coimbatore, but I have never come across them. I still have two mounted heads to remind me of the Poona days, and handsome little trophies they are.

NILGAI

These fine antelope carry such miserable heads that few sportsmen care to shoot them, except to assist the villagers in protecting their crops. The only one I have bagged was in Raipur in 1910, a good head as they go, but the best part of the trophy was his splendid iron-grey skin which made a very handsome rug for the floor. In later years I came across them on several occasions in Hyderabad State but never cared to fire at another, as the meat is generally wasted owing to the quite erroneous belief that they are in some way connected with the cow and that their flesh is therefore taboo. In the Nilgiris 25 years ago there was a solitary bull near Kullar at the foot of the Mettupalaiyam ghat, and at my suggestion the Nilgiri Game Assciation afforded him and his kin full protection. But no doubt he has passed on long ago, and I have never heard of any others in the district, though the broken country beyond Anaikatti at the foot of the northern slopes would seem ideal for them, and there are said to be a few in the Talaimalai forest just across the Mysore Ditch which forms the boundary between the Nilgiris and Mysore.

FOUR-HORNED ANTELOPE

My memories of this sporting little animal, so far as earlier days are concerned are rather vague. I know that I shot a number in the Central Provinces, generally in the course of chance beats for anything which might turn up, but I have only a single skull to

Photo *Col. H. G. Rossel*

Sambar.

Photo *Author*

My first Thamin.

Photo *Col. H. G. Rossel*

Blackbuck.

Photo *H. H. The Maharao of Kotah*

Bull Nilgai.

remind me of those days. One occasion however I do remember as it illustrates how easy it is to overlook an animal under certain circumstances. At the time we were hotfoot on the tracks of a bear when, coming to an open spot, my shikari suddenly stopped and whispered 'Maro'. Thinking he had spotted the bear I was looking round for something black, when suddenly two four-horns dashed away and were gone before I could lift my rifle. They had been standing not 40 yards away but so well had their colour blended with the dry grass and bushes that I had completely overlooked them.

Those which I shot in the C.P. had the full four horns, but in the Nilgiris I have never obtained a head with more than two, the front pair being represented by bony lumps under the skin. There are records of their being shot on the plateau 70 or 80 years ago, when they were termed 'Elliotts' or 'Mountain Antelope', but nowadays the few that survive in the district are to be found only on the thinly bushed grass land along the edge of the great ravine known as the Mysore Ditch, at the bottom of which flows the Moyar river. It was there that the two mounted heads I have were obtained some years before the war. They are extremely wideawake little animals and it is not easy to get within sporting range, while the fact that under the Game Rules only males may be shot, renders it still more difficult to bring one to bag, since even with fieldglasses it is hard to discern such small horns. Their usual alarm note is a sharp bark very like that of the kakar but slightly different in tone. Their venison, it may be added, is the best of any antelope or deer.

SAMBAR

This grand stag is, in my experience, far more difficult to bring to bag than a tiger; that is to say a good head. In fact it was not till I had shot several tigers that I secured my first sambar, and that was barely up to average. The finest stag I have seen was in Chanda in 1907, and it was entirely my own fault that I failed to get a shot. Breaking the rule which I used to observe while in the jungle, on that particular evening I was not carrying the rifle myself. Suddenly I saw a magnificent stag standing with a few hinds under a big tree not 100 yards away, the polished points of his antlers lit up by the setting sun. There was a slight delay in getting the rifle from the shikari whose attention was attracted in the opposite direction and who consequently had not seen the animals. That delay was fatal. Before I could take aim the sambar bolted out of sight, and though I ran hard after them to the river bank which I knew was just beyond, I was still unable to get a shot as they crossed and went up the opposite side, since one or other of the hinds hid the stag from my view. What a chance lost! That was very long ago, but many things I have seen in the jungle in later years are less clear to my mind than that grand stag. Comparing my memory of him with the massive heads which I saw in the Chief Commissioner's house at Nagpur not long after, I do not think his horns can have been an inch under 45 and the spread was huge. I have never seen his like again. And that was the last Indian sambar I was to see for many years, though I did shoot two of the Malayan type in Burma near Bhamo in 1914. Unfortunately however the larger, which was an unusually fine head, was in velvet, so the horns were useless to me though my Chinese munshi made quite a good sum by selling them to be turned into 'medicine'. The other was above average for the Malayan type, but they are at the best poor trophies compared with Indian horns.

The years passed and I began to wonder whether I should ever bag a decent sambar, when suddenly I had a real run of luck. I had been acting as D.A.A.G. to the Divisional Commander during the Moplah rebellion in 1921-22, and when the permanent incumbent returned from sick leave, I managed to fit in a few days leave at Masnigudi, near the foot of the northern slopes of the Nilgiris, on my way to rejoin my regiment. In those days nearly 30 years ago Masnigudi was a splendid shooting centre. There were any number of spotted deer within easy distance and, as I was soon to find, of sambar also. On the morning after my arrival I started at dawn to work the big lantana slope between the village and the stream, and within an hour spotted a stag in the bushes not 40 yards off. A quick shot in the neck brought him down, but I was disappointed to find the horns taped only 33 inches—he was an old beast 'going back'. Next morning was blank, so when I got back to the T.B. at 9.30 a.m. I went off at once in the car towards Teppakadu, 4 miles away, to see if I could pick up a junglefowl for the pot. We had not gone far when I noticed a sambar lying down in the open forest not more than 40 yards from the road. His head was laid out flat on the ground, and except for the horns he looked very like a cow asleep. He never moved when the car stopped, and we thought him dead till I saw an eye flicker. I was in doubt whether his horns were any larger than those I had secured the previous day, but while hesitating to fire he got up and went off, and then I saw that he carried a better head with a good spread. Two running shots brought him to a halt in a thicket and a final one behind the shoulder finished him, though he stood for at least five seconds after the shot before falling. I was using a .405 Winchester which should have been heavy enough, but the sambar is a very tough animal. The horns taped two inches more than the previous one, and I was pleased to have got a shootable head at last, for in the Nilgiris a 35-incher is considered quite good. There was a wound several days old in the chest, probably from fighting, and there were maggots in the liver. This was possibly the reason for his lying down in the open. The third morning I was off again at dawn across the fields behind the T.B., and soon saw a small lot of blackbuck, but no shootable head. Half an hour later I came across a herd of four sambar and another of eight chital, each with a stag, but no better than I already had. I watched them for some time at close range, but they did not bolt till we moved. We now heard sambar belling and monkeys cursing downhill on our right near the stream, evidently at a tiger or panther, so went to investigate, and soon spotted the sambar. I could see that the stag carried a fine head, so after verifying with my glasses that the horns were clear of velvet, fired at his shoulder. I ran round the bushes and found the herd standing motionless and the stag evidently very hard hit, so gave him another. He tottered off 30 yards and fell dead in a bush, and I was pleased to find that the horns measured 37½ inches, a head worth mounting. Three sambar previously in eighteen years, and then three in three days! It was too good to last, and though I still had one stag left on my licence, I decided not to tempt Fortune further, so packed up and left. Was I guilty of slaughter? I don't think so, as I was careful not to fire except at a head bigger than I had already obtained, and none of the meat was wasted. The story of that brief trip shows how plentiful deer were round Masnigudi in those happy days nearly thirty years ago. Conditions now are very different. Hydro-electric schemes have necessitated the construction of new roads, of which car poachers (chiefly by night) have made the fullest use. The result is that over a considerable area practically no sambar or chital remain, while blackbuck have been completely wiped out.

That Masnigudi shoot remains my best memory of this grand stag, for though I have shot half a dozen more on the plateau in the past 25 years, the details do not merit narration, and my ambition to bag a 40-incher is still unfulfilled. There was indeed one such stag in the great valley behind Bangi Tappal before the war. I sighted him more than once, but was never able to get within fair range, as his habits were so largely nocturnal that it was pure chance whether one selected the right spot for him to emerge from the *shola* before the light went, and this I never succeeded in doing.

As these Jungle Memories are written more especially for the novice, a few notes may be useful, and perhaps the most important of these is *velvet.* Unlike antelope, bison etc. whose horns have a bony core, all deer (including even the humble barking deer) drop their antlers periodically and grow fresh ones. While the new horns are forming they are said to be 'in velvet' and stags in this condition are very rightly not allowed to be shot. As the horns mature and solidify the stag rubs off the outer covering against small trees, and as soon as the points are clear and hard the stag is said to be 'in hard horn', even though strips of drying velvet are still adhering to the antlers. All this is very elementary no doubt, but it took me several years to discover exactly what happens, and perhaps there may be others equally uninformed. Nearly all deer shed their horns annually, but some sambar may retain theirs for two years or more; these are old animals 'going back', i.e. the antlers having attained their maximum length progressively decrease in size. Most sambar drop their horns about April and are in hard horn again before November, but I have records in my diaries of stags seen on the Nilgiris plateau in hard horn for every month of the year. As regards annual increase in horn length, S. Haughton's *Sport & Travel* records an instance of a young sambar kept in captivity in Ceylon whose horns increased from 5½ inches in January 1877 to 25 inches in February 1882, i.e. approximately 20 inches in 5 years. It would be interesting to have more data on the subject. In the Central Provinces among picked up horns I noticed there were two distinct types as regards colour, one yellowish and the other black. These were referred to by the Gonds as 'peelia' and 'telia' respectively; in South India I have met none except the latter. A peculiarity of this deer is the curious bare patch, often raw, on the skin at the base of the neck, the cause of which is unknown. In Burma I found that all sambar had this 'sore neck', but on the Nilgiris it is not so common. The stags fight desperately during the rutting season, and once I found the bodies of two with horns inextricably interlocked near Kolimund in the Kundahs; an extra tine at the end of one antler had apparently caused the tragedy. Sambar are very difficult animals to drive owing to their natural cunning, and the best way to bag a stag is either by still-hunting or by stalking. The open grassy slopes of the Nilgiris plateau overlooking the *sholas* where they lie up for the day, afford good opportunities for the latter, and though sambar do not carry such fine heads as used to be found in the north, a keen sportsman should have no great difficulty in securing a really good specimen in the Nilgiris. Forty inches are of course rare in the south, but a fine head of 36 inches with a wide spread was bagged on the High Range of Travancore as recently as March 1951. This would be good anywhere in India nowadays.

CHITAL

Books on shikar and natural history are unfortunately only too prone to repeat without verification statements made in previous works, and thus in some cases perpetuate mistakes. One of these is the entirely fallacious idea that spotted deer in South India carry much smaller heads than those in the north. How this idea arose it is impossible to say, but even *The Book of Indian Animals* falls into the same error, for it states that 'a 34-inch antler would be good anywhere; 31 inches in South India'. Far finer horns than the latter have always been and still are available in the low country of the Nilgiris and in the Wynaad, and it is doubtful whether better can be found today anywhere in India. I might add that for many years I set myself a *minimum* of 34 inches!

Before the Mudumalai Wild Life Sanctuary was formed in 1938 that area was a favourite hunting ground of mine, and it was there and in the adjacent Doddakatti block that I obtained my best heads. Most of the bucks are clear of velvet by the end of May, and it is then that they start roaring and give a useful clue to their whereabouts. One day is so much like another—the start at dawn, the slow hunt till the herd is sighted, the endeavour to locate the master buck, the circumventing of watchful does, and the final crawl to the cover of some convenient tree or bush—that none merit more detailed narration. So I will relate one episode only, and that the story of my finest buck. During May 1923 I was in camp with the D.F.O. at Mudumalai, and late one evening came across a large herd of chital feeding over a *maidan* where the burnt grass was sprouting. There were several good bucks, but the master of the herd carried an exceptionally fine head, with a wide spread and those false points above the brow antler which add so greatly to its appearance. I had already shot the two bucks allowed on my licence, so after watching him for some time, left him in peace and returned to the bungalow. It was not till four years later that I met him again, though in the meantime I had searched long and often. On the day in question I had been out since dawn, and had fired at a good buck, but my bullet had been deflected by a branch. On the way back to the Hut, as I reached the Teppakadu cross-road I suddenly saw a small herd of chital in the bamboo jungle on my left, and with them, quite unmistakably, my old friend. They were off at once, and as the buck disappeared behind a bush, in despair I fired a snapshot through it. I did not know whether I had hit him or not, but when I ran up I was delighted to find him lying there. The bullet had entered the throat and come out at the back of the neck, and how he came to be standing at that angle I cannot imagine, unless he had paused for a final look through the bush at us. Anyhow it was one of the biggest flukes I have ever brought off! He appeared moribund, but after we had dragged him the short distance to the road he began to revive and kick, so I had to give him another quick shot through the heart, otherwise I think he would have been off. The original bullet had passed close enough to the vertebrae to stun him, but that was all. The horns were all that I expected, only half an inch short of 38 in.; and his grand head looks down on me as I write to remind me of that lucky chance. Subsequently I obtained another equally good head (but with a more narrow spread), and I know of two more shot in the same forest which taped the full 38 inches. I mention these measurements to disprove once and for all the idea that good heads are not obtainable in South India. It is true that much of the best ground is now included in the Wild Life Sanctuary, but beyond it again lie the Honurhatti salt-licks and the grassy *maidans* of the Doddakatti block so seldom visited by sportsmen, where one can still be sure of a really good head.

There are no horns so difficult to judge as those of the spotted deer. Some have a wide spread and others are narrow; some curve back while others go up almost straight, and it is therefore well before firing (especially in an area where a size limit is imposed) to view the head from different angles. The additional short point or 'sprag' at the base of the brow antler certainly indicates an old buck, as does also a dark coat, but neither of these is any certain indication of horn length, for the head may be 'going back'. So the sportsman who has bagged his buck need not be surprised to find that the antlers have shrunk two or more inches when he comes to run the tape over them! First thoughts on the size of a head will probably prove the most accurate.

Chital are far more irregular in dropping their horns than sambar, and buck in hard horn may be found throughout the year, but in the low country of the Nilgiris the majority will be clear of velvet by the end of May, and it is then that they start roaring. At this season one often hears the sound of antlers clashing as two bucks fight, but fatal results are in my experience very exceptional, though I remember one beaten buck pass close to me near Doddakatti with a gaping wound in his stomach obviously from his opponent's horn, and most bucks brought to bag will be found to bear traces of battle. Chital suffer terribly from the depredations of wild dogs, but obtain some respite at those seasons when the tall elephant grass in the Mudumalai and Benne forests renders hunting difficult, not only because scent and visibility are poor, but also because the dogs fear cutting their pads on the sharp blades of the grass. The spear grass at Anaikatti after the monsoon acts as a similar deterrent for a period.

Are there two types of chital, large and small? My old Kurramba shikari, Kempe, asserted that there were, and at his request I once shot a buck with well-formed sprags whose antlers measured only

32½ inches. This he assured me was the smaller type, but personally I think it was an old beast 'going back', though the body certainly appeared below average. Unfortunately I kept no other measurements.

THAMIN

It was in April 1913, while stationed at Rangoon, that I had my first chance at the Brow-antlered Deer, to give him his alternative name. On the advice of a friendly Conservator I went to Paungde some way up to the line towards Prome, and then marched seven miles to the Mataing forest bungalow where I camped for several days before moving further on. On my second morning after wandering about for some time, I came across a herd of half a dozen thamin, the stag being noticeably larger and darker than the hinds. I had an easy chance at 50 yards but a tree covered the stag's shoulder, and while I was trying for a clear shot he spotted me and bolted. A running shot broke a hind leg, and some dogs bailed him up in a field 300 yards on. As I ran up to finish him off I fell base over apex into a *choung* (nullah) eight feet deep, but no harm was done. The head was quite a nice one, 33½ inches with a brow antler of 15. Re-reading my diary of that trip I am amazed at the amount of game I saw. Every day I came across thamin, while *gyee* (barking deer) were so common that one or more could always be beaten out of the gardens near the village. There were several panthers about and not far away tsine were to be had. I remember too that at one camp a band of dacoits threatened to raid the village, but finally decided to wait till I had moved on. I was rather disappointed when they failed to turn up!

My best thamin was obtained on my last afternoon. We were strolling down a forest path only 1½ miles from camp when suddenly I saw three stags staring at us within easy range. Two carried quite good heads, but the third was like none I had seen. They were off before I could take aim, but my *mckso* (shikari) rushed me down the path and as we reached a clearing two cantered across my front at 50 yards range. I let them go and then as the big one passed a whistle brought him to a halt and a solid bullet from my .303 (all I had left) broke both shoulders. He went on some 20 yards and fell. The head was a magnificent one, measuring 38½ inches with a brow antler of 14½. It was of the unusual spatulated type with no less than 13 points instead of the normal six. The memory of that stag is one of my clearest mental photographs, and I still have the head to remind me of those happy days so long ago.

Are there any thamin alive in Burma today? I very much doubt it, for even before the last war they had already been shot out in many parts, and the Jap occupation and subsequent civil war must have wiped out the few remaining specimens of this fine deer.

HOG DEER

My best memory is of one knocked over with a snapshot from my .303 as it bolted across a clearing in long grass. Not a difficult shot really, and the head was not a good one, but it is the only one I have kept. While stationed at Bhamo in 1913-14 we used to go after them and anything else which might turn up, beating the grass-covered islands of the Irrawaddy with the nine Commissariat elephants (formerly King Thibaw's) which we were allowed to hire on Sundays at one rupee each. Very pleasant outings those were, though I do not recollect much ever being brought to bag. But I do remember two really good hog-deer seen in 1921 near Mandalay, neither of which afforded a shot. The first was drinking at the canal as we motored along the bank early one morning on our way out to a snipe shoot. It was gone before we could unpack our guns, and the canal effectively prevented pursuit. The second suddenly bolted out of a very small patch of scrub in the middle of a lot of rice fields while we were shooting snipe. I was loaded with No. 9 shot at the time, and before I could change to S.G. the buck was out of range. And of course both these heads were far finer than the single trophy I have. It is so often thus !

KAKAR

More commonly known as Barking Deer, or in the Nilgiris as Jungle Sheep, this sporting little animal has provided me with lots of fun, as well as most excellent venison. But when it comes to individual memories, I must confess that I have few, many though I have shot. Some however do stand out. There was the buck that trotted out towards me in a beat near Paungde which I missed disgracefully, only to roll it over with a second shot from my .303 when it was some way off and going sixteen annas. Another stalked near Yinmabin while drinking at a water hole was missed because the bullet hit a bamboo and was deflected. Yet another near Mukerti Peak on whose shoulder the bullet exploded without penetrating but which was knocked over dead, like the chinkara referred to above; and a semi-albino shot near Avalanche many years ago whose flanks were almost pure white. A very old buck that, with exceptionally long pedicles but very short horns; obviously 'going back'.

But the one which intrigued me most of all was a buck shot near Meiktila in 1920. We were out one evening looking for thamin and from some rising ground spotted an animal feeding in some light scrub about half a mile away. It was so dark in colour that my Burmans were positive it was a thamin, though I could see with my glasses that it was a *gyee,* as the kakar is termed in Burma. Anyhow I got him and they declared they had never seen such a one before, nor had I, for that matter. The coat was exactly the same sepia colour as a thamin's, quite different from the usual tawny yellow or reddish shade of the kakar. Later I wondered whether I had not by luck obtained a specimen of Fea's Muntjac, but unfortunately both skin and skull were purloined by an acquisitive pie-dog while drying behind my bungalow, so I was unable to pursue the matter further.

The kakar is often obtained by beating, when a charge of S.G. will roll him over; the use of small shot is neither effective (except at very close range) nor sporting, and is in fact forbidden by the Game Rules in many places. The most satisfactory way is to stalk him with a rifle early in the day or late in the evening. He is such a sporting little chap that he merits a bullet in preference to a charge of shot. In the interests of game preservation only the males should be shot, but it is not always easy to differentiate, for an old female generally has tufts of hair covering fleshy knobs which look remarkably like short horns; the duller and darker coat of the male will however usually indicate the sex. Small as the heads are, when well mounted they make handsome trophies; the best I have measures just under 6 inches, excluding of course the pedicles. The latter are in my experience longer in the Nilgiris than further north and apparently increase with age. As is well known the barking deer is so called from his alarm note which is remarkably like a dog's bark. When heard, it pays to investigate, for there may be the chance of a shot at a tiger or panther, but I have known them to bark at red mongooses and even at black langurs.

MOUSE-DEER

Our list would be incomplete without some mention of the Indian Chevrotain, to give him his full name, which is almost as long as the animal itself. The first I saw was in the Poona days while beating for panther near Khandala. It passed under my tree but was of course not fired at, as I was expecting worthier game. Then for many years I never saw one, but after retirement came across them in the low country of the Nilgiris, where every year a few are shot in small game beats. The first I got was killed by chance as I was driving in the Mudumalai forest before dawn. In the indistinct light I thought it was a wild cat so ran over it. Another curious incident occurred in the Benne forest two years ago. The whole area had been burnt and young grass was sprouting. I was wandering along on the look-out for a pig when I heard a subdued grunting noise, so got behind a tree and waited. Shortly after a mouse deer ran past almost within touching distance, grumbling to himself and obviously in a very bad temper. I was just going to move on when a large red mongoose appeared, following intently the same line, and passed without seeing me. Presumably it was after the mouse deer, but what eventually happened I cannot say, as both animals went out of sight. Incidentally the flesh of the mouse deer is the best of any game animal in India; possibly the mongoose was aware of the fact, and he was not hampered, as I was, by any consideration of the close season!

(To be continued)

BIONOMICS OF THE MRIGAL, *CIRRHINA MRIGALA* (HAM.), IN SOUTH INDIAN WATERS

BY

P. I. CHACKO AND S. V. GANAPATI

(*Freshwater Fisheries Biological Station, Madras.*)

The Madras Fisheries Department has been importing Mrigal from Bengal since 1943 (Jagannathan, 1946), evidently not being aware of its natural occurrence in the Godavari and Krishna rivers, for distributing it into departmental farms in the Chingleput, North Arcot and Kurnool districts. Recently Alikunhi (1949) and Chacko (1949) recorded regular fisheries of the species from the Godavari and Krishna rivers. The fish has now been stocked artificially in the Cauvery and Tungabhadra rivers, but it is too early to say whether it has established itself in these rivers or not. The acclimatisation and growth of this species in the South Indian farms have yielded some interesting results which it is the purpose of this article to describe.

Mookerjee, Mazumdar and Gupta (1944) have studied the breeding grounds and spawning habits of Mrigal in the Midnapore district. Mookerjee and Ghosh (1945) have made preliminary observations on the food of the fish. Khan (1924, 1942, 1943) has described the spawning grounds, breeding habits and early development of the species in the Punjab. In the present communication an attempt is made to record some observations on the bionomics of Mrigal in South Indian waters.

COMMERCIAL FISHERY: As already pointed out by Alikunhi (1949) and Chacko (1949), the Mrigal contributes on an average 20 per cent of the catches in the Godavari and Krishna rivers and the connected tank-systems.

FOOD AND FEEDING HABITS: Mookerjee and Ghosh (1945) have stated that the Mrigal takes a mixed diet but that the animal diet is almost negligible in comparison with vegetable, and that the major portion of the diet is the higher plant bodies in semi-rotten condition. According to their findings, it would appear that the fish feeds at the bottom on organic debris. Examination of the stomach contents of South Indian specimens ranging from 2 to 30 inches has indicated that in Madras waters the Mrigal feeds mostly on blue-green algae, green algae and diatoms. Flagellates, rotifers and microcrustaceans are also consumed in very small quantities. The following is a comprehensive analysis of the diet of the fish:—

Myxophyceae: *Anabaena, Anabaenopsis Gleotrichia, Merismopedia, Microcystis, Oscillatoria* and *Spirulina;*

Chlorophyceae: *Ankistrodesmus, Closterium, Cosmarium, Crucigenia, Mougeotia, Oedogonium, Oocystis, Pediastrum, Pleurococcus, Pleurotaenium, Scenedesmus, Selenastrum, Staurastrum* and *Vaucheria*;

Bacillarieae: *Amphora, Cyclotella, Cymbella, Eunotia, Fragilaria, Frustulia, Gomphonema, Hantzschia, Navicula, Pinnularia, Stauroneis and Synedra*;

Protozoa: *Euglena, Glenodenium, Glaucoma, Pandorina, Phacus, Paramoecium* and *Stylonichia;*

Rotifera: *Conochilus, Diurella* and *Pedalion,* and

Crustacea: *Alonella, Bosmina, Ceriodaphnia, Cypridopsis, Diaptomus* and *Eucyclops.*

Mud and dark mucilaginous matter are frequently met with in the stomach contents showing that it feeds at the bottom also. There is no difference between the food of the young and the adult. The predominant herbivorous habit of the fish is indicated by its long intestine, which measured 50 feet in a specimen of 30 inches in length.

MATURITY: Practically no published data are available on the age of maturity of the Mrigal. It is generally considered that the females of the major carps become sexually mature not before they are two years old. But Mrigal fry of both sexes, about one month old, stocked in Chetpat Fish Farm, Madras, in August 1948, were found in July 1949 to have their gonads filling the body cavity. The milt was oozing from the males and the gonads of the females were in the 5th stage. Similar observation was made in June 1950 on Mrigal fingerlings stocked in the same farm in September 1949. It can therefore be assumed that the male of this species attains full maturity at the end of the first year and the female sometime later. That the males mature earlier than the females has already been recorded by Hora and Nair (1943) in the case of *Barbus* (*Lissocheilus*) *hexagonolepis*, by Chacko and Ganapathi (1949) in the case of *Hilsa ilisha* and by Alikunhi and Nagaraja Rao (1951, *in press*) in the case of *Cirrhina reba*. The number of ova in one female individual averages about two lakhs.

BREEDING SEASON AND SPAWNING CONDITIONS: The fish has been observed to spawn in the Godavari and Krishna rivers from July to September, i.e., during the south-west monsoon season, when the rivers are usually in spate. During this period, hatchlings and fry of all the major carps have been collected from the entire stretch of the rivers. Later, in October and November, fingerlings of Mrigal, are obtained from the irrigation tanks and paddy fields fed by the canals starting from the Dowleshwaram and Bezwada anicuts across these two rivers. The hydrological conditions during the spawning are generally as detailed below.

HYDROLOGICAL CONDITIONS FAVOURABLE FOR THE SPAWNING OF *Cirrhina mrigala*

Physico-chemical conditions	Godavari below anicut	Godavari near Jallakalva	Krishna above anicut
Date	22–7–48	14–9–49	21–7–49
Colour	brown	brown	brown
Turbidity (cm.)	1·5	1·5	1·2
Temperature °C	27·2	29·6	28·1
Depth of water (ft.)	5·2	10·0	10·3
Rate of flow	rapid	moderate	rapid
Dissolved oxygen (cc/1) ...	4·877	2·93	5·460
% saturation	83·7	52·2	94·1
pH	8·2	8·0	8·3
Chloride (pp. 100,000)	1·0	0·8	1·0

The hydrological conditions of the nursery areas where the fingerlings occur are as follows:—

HYDROLOGICAL CONDITIONS PREVAILING IN THE NURSERY AREAS OF *C. mrigala*

Physico-chemical conditions	Pond in the midst of paddy fields in Hussainipuram	Paddy-field canals near Ramachandrapuram
Date	20–9–49	17–9–49
Time	10.20 a.m.	4.15 p.m.
Colour	brownish	brownish
Turbidity (cm.)	5·4	5·6
Temperature °C.	28·0	33·8
Rate of flow	—	sluggish
Depth (ft.)	3·5	3·0
pH	7·8	7·6
Dissolved oxygen (cc/1)	1·89	2·93
% saturation	32·8	—
Chloride (pp. 100,000)	4·0	1·2

From a comparison of the conditions of the spawning and nursery grounds, it would be seen that the spawning grounds are characterised by (1) a lower range of temperature from 27.2 to 29.6°C (81.0 to 85.3°F. *versus*, 82.4 to 92.8°F.), (2) deeply coloured water *versus* clearer water, (3) higher turbidity (1.2 to 1.5 cm. *versus* 5.4 to 5.6 cm.), (4) higher percentage of saturation of dissolved oxygen (52.2 to 94.1% *versus* 32.8%), (5) higher range of pH (8.0 to 8.3 *versus* 7.6 to 7.8), and (6) low chloride content (0.8 to 1.0 pp. 100,000 *versus* 4.0 pp. 100,000). These differences might be due to the flood conditions in the spawning grounds as against the normal conditions in the nurseries.

Khan (loc. cit.) has observed Mrigal breeding in shallow areas of flooded streams in the Punjab during the rainy season when the temperature of water ranged from 76 to 98°C. Mookerjee *et al.* (loc. cit.) found that the Mrigal spawned in the shallow areas of the bundh-type of tanks in Midnapore district, Bengal, when the pH of the water rose from 7.4 to 7.9 after a shower. A similar increase in pH and oxygen content over the corresponding factors in the nurseries is noticed in this case also.

FACTORS INFLUENCING THE SPAWNING OF THE MRIGAL: Hora (1945) reviewing our knowledge of the breeding conditions of Indian carps, stated that a heavy monsoon flood is the primary factor that influences the spawning of Indian carps and that the other topographical, chemical and physical changes in the environment of the fish are entirely dependent on it. Mookerjee (1945), on the other hand, considers dissolved oxygen as a factor of primary importance in inducing spawning of fish. According to him practically no freshwater fish spawns without some amount of rain water mixed with the old water of the pond, and for major carps almost pure rain water is needed for spawning. But Ganapati and Alikunhi (1950) have shown that spawning depended mainly on the availability of suitable shallow spawning grounds and have pointed out how the observations of Khan (1924, 1947) also point to the same conclusion.

In the case of the Mrigal, the factors influencing spawning in the Godavari and Krishna rivers seem to be due to the availability of shallow spawning grounds. As already pointed out, the fish has been observed to spawn in the two rivers during the south-west monsoon season (July to September). Just prior to this period is the hot weather, when the rivers are almost dry exposing large areas of sandy region, and depth of water is very low and the water gets heated considerably. Specimens caught and examined during this hot period (March to June) were always in the last stage of gonadial development. That intensified respiration is necessary during the period of ovulation is well known; and this is taking place in the case of the major riverine carps during the summer months when the temperature is comparatively higher. This is also confirmed by the observations of Smith (1945) that the Mahseer only congregate at river junctions in order to become pregnant by the warmer water and not for feeding purposes as is commonly believed. Once the gonads are ripe, there is no need for intensified respiration. The fish, thereafter, seem to need a comparatively quieter period of lower metabolic activity in order that they may be able to concentrate on the only all-absorbing life instinct of spawning. The fish cannot do this act of spawning in the middle of a river in great floods, where the current is powerful. They have naturally to seek quieter shallow areas both in their own interest and of those of their spawn and fry. But with the onset of the south-west monsoon floods in the Godavari and Krishna rivers, the exposed sandy beds are covered with flood water and thus large areas of shallow portions are made available not only in the river-proper but also in the adjoining areas where streams and drainages enter the rivers. Such places are seen all along the rivers, where the fish congregate, sport among themselves and shed their reproductive elements. It will thus be evident that the availability of shallow spawning grounds is the important single factor which has to be reckoned for carp spawning. This inference is also supported by two common observations—(*a*) the inability of the major carps to spawn in confined waters (fish ponds), and (*b*) spawning taking place only in the bundh-type of tanks as in Bengal. The main difference between the fish ponds and bundh-type of tanks is the availability of shallow spawning grounds in the latter. If on the other hand, temperature is the main factor, the inability of the fish to spawn in fish ponds immediately after the onset of monsoon rains, when the right temperature of water is recorded cannot be explained. So, the main factor appears to be the availability of shallow spawning grounds.

COLLECTION OF FRY AND FINGERLINGS: The fry and fingerlings of Mrigal are usually collected by means of basket traps set against the flow of water in the numerous irrigation canals and channels. The percentage composition of the catches made by these basket traps in September 1949 was as follows.

Kind of fingerling	Percentage
Catla catla	10
Cirrhina mrigala	8
Labeo fimbriatus	10
L. calbasu	2
Cirrhina reba	10
Other miscellaneous carps, minnows ...	40
Murrels, eels and cat-fishes	20
Total ...	100

The natural nurseries of this species thus located are being utilised for stocking inland waters in Madras State. The fry and fingerlings of Mrigal stand transport well, the casualty during transhipment not exceeding 30 per cent.

GROWTH RATE: In Bengal, where the fish feeds on organic debris, the average growth is 7 inches in the course of three and a half months (Basu, 1946). In Madras, the growth is more rapid on account of its somewhat different feeding habits. The fish is found to attain a size of 18 to 24 inches and a weight of 2.5 to 4.0 lb. at the end of the first year in some of the tanks and swamps of the Godavari and Krishna districts. As these waters dry up during the summer and the pond bottom gets naturally fertilised, it is evident, therefore, that the rate of growth of this species is accelerated in such waters owing to abundance of food. In the Chetpat Fish Farm, where large areas of the bottom dry up annually, the Mrigal has attained 22 to 26 inches and 3 to 5 lb. in one year. The following is the recent record of growth rate of Mrigal fingerlings (3-5 inches) stocked in December 1949 in the Ichapur Fish Farm in North Vizagapatam, into which sullage is drained:

Month	Growth in inches
January 1950	5—6
February	5—8
March	7—9
April	9–12
May	10–14
June	12–15

The same stock of fingerlings have attained a size of 14 inches and 15 inches by June 1950 in the Dykes tank at Vizagapatam and in the Government House Farm at Madras respectively. In the former, a certain amount of sullage is drained into while the latter forms a catchment for a vast area from which dead organic matter gets drained into the tank. The average growth-rate in such fertilised waters during the first year is thus 1½ to 2 inches per month. In some other waters like the Dhobi tank, Chodavaram tank and Abbi tank in the Ramachandrapuram area, which are not so well fertilised and therefore not so rich in algal flora, the growth of the fish is poorer, being only 10 to 15 inches and 12 to 16 ounces in the first year. It is evident that the waters having abundance of algae or in well-fertilised ponds, the Mrigal can be fattened more rapidly.

IMPORTANCE IN RURAL PISCICULTURE: The easy availability of its young stages in the Godavari and Krishna systems, non-cannibalistic habit, and good rate of growth make Mrigal a valuable addition to the fishes that are utilised for rural pisciculture in the Madras State. As the Mrigal is a bottom-feeder, it is also a scavenger fish and can be used advantageously in waters containing organic debris at the bottom. Thus it can form a useful association with other species that feed mostly on the surface or in the column of the waters.

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SUMMARY

The Mrigal contributes on an average 20 per cent of the commercial fisheries in the Godavari and Krishna rivers. It feeds in mid-water mostly on blue-green algae, green algae and diatoms. It feeds at the bottom also. The male attains full maturity at the end of the first year. The fish breeds in the rivers during the south-west monsoon season. A comparison of the hydrological conditions of the spawning and nursery areas show that the former is characterised by a lower range of temperature, discoloration of water, higher turbidity, higher percentage of dissolved oxygen and higher pH. The availability of shallow spawning grounds in the river bed is considered to be the main factor influencing spawning of the fish. The growth-rate is rapid, about 1½ to 2 inches per month, in the first year in fertilised waters. The species is now of rural piscicultural value in Madras.

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THE BIRDS OF COORG

BY

F. N. BETTS

PART I

(*With a map*)

FOREWORD

The following paper is intended to be a commentary on the Reports of the Surveys carried out in Mysore and Travancore and Cochin States by Sálim Ali and complementary to them. It is the result of ten years field work in which I collected eggs but no skins, and amassed a quantity of notes on habits and distribution which I hope will help to fill out the framework provided by the Surveys, along with which it is intended to be read.

The notes are entirely the result of personal observation, and in no case have I drawn on hearsay or other written sources except where expressly stated.

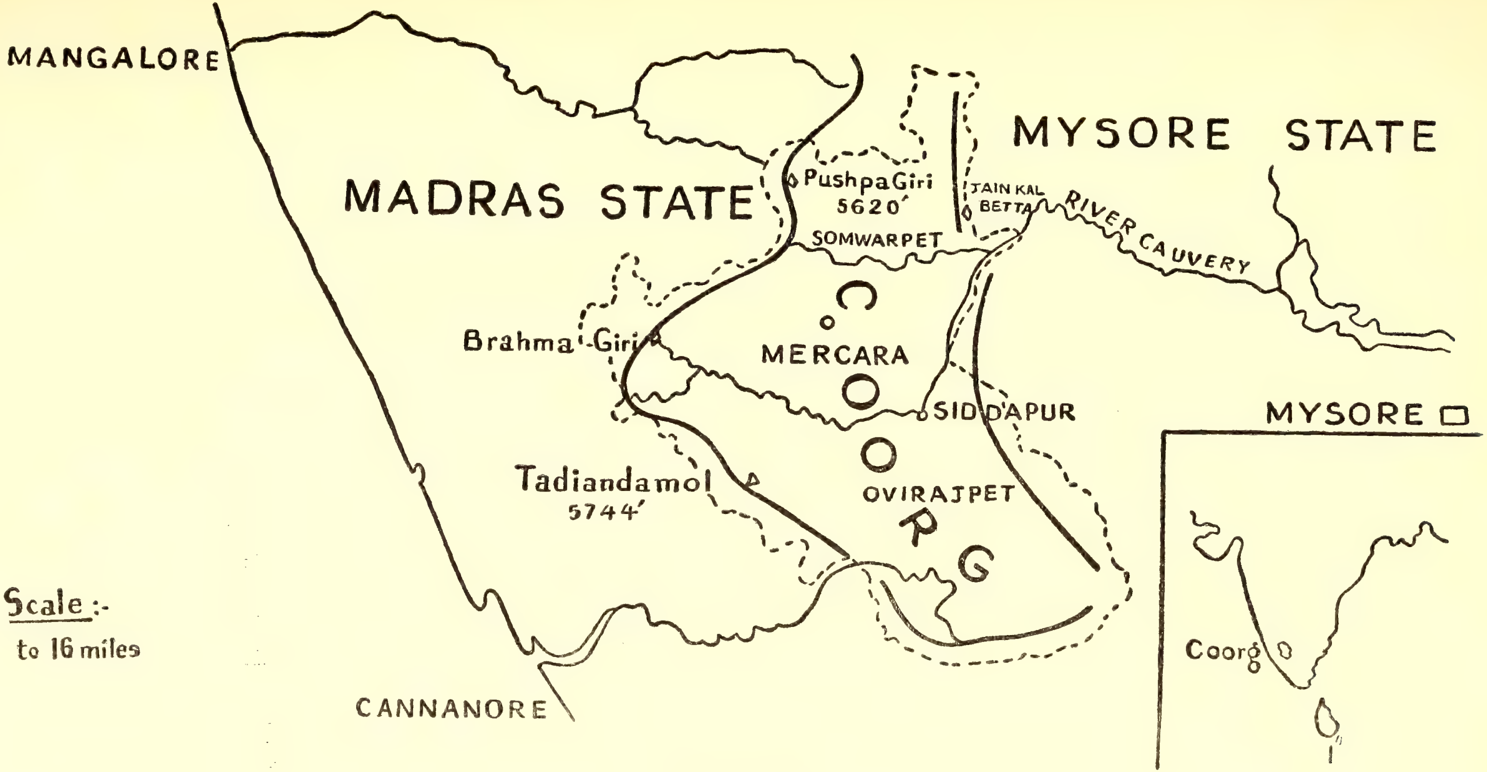
I have used binomials as no skin collection was made, but in practice there could have been very little risk in using the trinomials of the Mysore Survey.

A tribute is due to the thoroughness of Mr. Sálim Ali's work. In the short space of six months, covering a very wide area, and some exceedingly difficult country for the collector, I think that it is improbable that a single resident species with the exception of one or two waterfowl was missed, and his two papers in conjunction form a classic basis for the study of the avifauna of S. W. India.

PHYSIOGRAPHY AND CLIMATE

In both these respects Coorg is merely an extension of the 'Malnad' of Mysore State, with the exception of a very small area at the foot of the Western Ghats, which is typical Malabar Tropical Rain Forest, and, on the east, a tract of dry country in the Fraserpet district resembling the adjacent Mysore 'Maidan'.

The physiography of the Province is clearly defined. On the west it is bounded by the line of the Western Ghats, rising from the coastal plain at 2/300 feet elevation to peaks reaching at their maximum 5,800 ft. To the east of this range lies the main body of the Province, an undulating basin, roughly twenty-five miles broad, formed by the courses of the Cauvery and its numerous tributaries. The elevation ranges from 2,750′ to 4,000′ with a general average of 3,000′. The eastern border is marked by another range of low hills running north and south, only broken at Fraserpet where the Cauvery debouches into Mysore. North east of Fraserpet, beyond this range, lies the small but very important tract of 'maidan' country.


MANGALORE
MADRAS STATE
MYSORE STATE
PushpaGiri
5620′
JAIN KAL BETTA
RIVER CAUVERY
SOMWARPET
COORG
MERCARA
Brahma Giri
SIDDAPUR
OVIRAJPET
Tadiandamol
5744′
CANNANORE
Scale :-
to 16 miles
MYSORE ▭
Coorg

COORG

METEOROLOGY

The climatic zones correspond very closely with the geographical. By far the greater part of the rainfall is precipitated during the S. W. monsoon. Irregular showers begin in April and May; steady rains follow through June, July, and August with strong westerly winds. A break occurs in September, followed by the thunder showers of the N. E. monsoon in October. From November till the end of March, except for one or two showers, there is seldom any rain.

Western Ghats: The rainfall on the western slopes is enormous: 250+″. The Malabar foot is always moist and hot, varying little in temperature throughout the year. On the hill tops the monsoon months are probably generally the coldest on account of the strong winds, but the very highest peaks are occasionally touched by frost in winter.

Central Basin: The rainfall decreases very rapidly from west to east. On the eastern slopes of the Ghats as much as 150″ is experienced, while the eastern ridge receives no more than 50/60″. The average over most of the basin is 60/80″. The climate is remarkably equable, the temperature rising occasionally to 90° for a few days at the end of March before the first rains which is the hottest time of year. The summer is cool on account of the rain and strong winds of the S. W. monsoon, while, even in the winter, the nights rarely drop below 55°.

Dry Zone: Here the rainfall is less than 40″, a good deal of which falls in the N. E. monsoon, and summer temperatures are much higher.

BIOTOPES

The following biotopes are clearly distinguishable. A full description appears in Sálim Ali's paragraphs on the Mysore Malnad and Maidan and only a brief recapitulation is made here.

Wet Zone:

The Malabar coastal plains and the western face of the Ghats. Up to 4,000′ this is covered in dense Tropical Evergreen Forest (Champion, Group 16, Type C). Above this height the forest, while remaining evergreen, becomes dwarfed and less tropical in character, The peaks are usually bare of trees and under short grass, and are often crowned with cliffs and rocky crags.

Intermediate Zone:

Moist Intermediate: This comprises the eastern slope of the Ghats and that part of the central basin immediately at their foot. The slopes of the hills are under short grass interspersed with evergreen sholas, mostly small trees with an undergrowth of 'eeta' bamboo, rattan canes, and *Strobilanthes*. Cardamom and coffee plantations grown under shade cover considerable areas, and the valleys are mostly under paddy cultivation often with thickets of *Pandanus* along the streams. There is little *Lantana*. Forest types: Southern Tropical Semi-evergreen (Group 2A, Type C2).

Dry Intermediate: This lies to the east of the last, generally at a lower elevation and comprises the greater part of the central basin. It is the most thickly populated area. Cultivation consists of wide stretches of paddy land along the streams especially in the south; coffee, pepper, and orange plantations. The coffee is grown under shade usually of mixed types, both indigenous and exotic, including such species as *Grevillea robusta*, *Terminalia tomentosa*, *Dalbergia latifolia*, *Erythrina lithosperma*, *Bombax malabaricum*, and various varieties of *Ficus* and *Albizzia*. A great number of these bear fruit and flowers attractive to birds, while the large numbers of standing dead trees, ringed during shade control operations, provide unlimited breeding sites for hole-nesters, with the result that the coffee land probably carries a greater and more varied bird population to the acre than any other form of agricultural activity in the whole of India.

Lantana aculeata in impenetrable thickets covers all open land not kept under cultivation or steadily grazed. In the north of the area, particularly, there are considerable stretches of grassy downland, known as '*bane*', kept down to a short turf by hordes of hungry cattle.

Deciduous Forest Belt: A strip ten to fifteen miles broad running all along the eastern border of the central basin and including the eastern ridge. This is uninhabited reserved forest, mostly Southern Tropical Moist Deciduous, (Group 3A–Type C1), characterised by Teak, Nandi, Matti, Rosewood, and other valuable hardwoods intermingled with the thorny, deciduous, giant bamboo *Bambusa arundinacea*. In the dry country beyond the eastern ridge it merges into Southern Tropical Dry Deciduous (Group 4A, type C2) of a scrubbier type with little bamboo.

Dry Zone:

This is characterised, on the flat land along the Cauvery, by typical Mysore 'Maidan' dry cultivation; ragi, sorghum, and oil seeds and pulses. The uncultivated portion is mostly open short grass and scattered thorny scrub with much lantana (Southern Thorn-Group 5A). There are a number of low rocky ridges running parallel to the main eastern ridge, and one or two small tanks, the largest, Halagote, not more than fifty acres in extent, which provide the only habitat for waterfowl in the whole Province.

GENERAL NOTES ON THE AVIFAUNA

Before coming to a detailed consideration of the birds of the Province, there are one or two very striking general features which call for comment.

MONTANE SPECIES

A number of species occurring, in most cases commonly, on the Nilgiri Plateau appear to be completely absent from Coorg even in apparently similar facies at the higher elevations on the Ghats. In most cases the Mysore Survey found them in the Billigirirangan Hills, while one or two turned up again in the Bababudans. These latter hills being north of Coorg, the birds concerned may yet turn up in the Province. Nevertheless the Billigiris do seem to form a very definite limit to the distribution of a number of species. This is quite understandable, as these hills, though cut off from the main tableland by the deep but narrow valley of the Moyar River, are really an extension of the Nilgiris, which are separated from the main spine of the N. Malabar and Coorg Ghats by the broad Wynaad plateau at an elevation of only 3–3,500′.

1. *Trochalopteron cachinnans.*

Confined to the Nilgiris. *T. jerdoni* is supposed to occur in Coorg, but I am fairly sure this is a mistaken report, although there is plenty of the *Rubus* facies so attractive to these birds on the high hills.

2. *Brachypteryx major.*

Common in Nilgiris and Billigiris. Frequent in Bababudans.

3. *Parus major.*

Very common on the Nilgiris and found in Billigiris, but rare in Coorg and there only in the Dry Zone.

4. *Oreocincla dauma.*

Nilgiris and Billigiris, but always rare and easily overlooked.

5. *Eumiyas albicaudata.*

Nilgiris, Billigiris and Bababudans. A common and conspicuous bird in the Nilgiris, but must be very rare if at all occurring in Coorg.

6. *Ochromela nigrorufa.*

Nilgiris and Billigiris.

7. *Anthus nilghiriensis.*

Nilgiris only.

8. *Alauda gulgula.*

Nilgiris only.

9. *Saxicola caprata nilgiriensis.*

The Coorg bird is almost certainly subsp. *caprata*, as it avoids the high downs beloved by the Nilgiri Bushchat, and inhabits an entirely different biotope.

10. *Hirundo javanica domicola.*

Nilgiris only.

Ecological Parallelism in the Wet and Dry Zones

In Coorg there are two very markedly distinct faunal zones, one including the Wet and Inter Zones, and the other the Dry Zone. The boundary is most definite and runs along the crest of the eastern ridge, though certain Dry Zone species do wander across this in the dry weather. One has only to cross the ridge to find a completely new set of birds. While there are many forms which are represented solely in one zone or the other, a remarkable and immediately noticeable parallelism exists, in which a species on one side is replaced by another nearly related species on the other side, occupying the corresponding ecological niche.

TABLE OF ECOLOGICAL PARALLELS

	A. Wet Zone	B. Dry Zone
1.	*Dendrocitta leucogastra* (West only)	*D. vagabunda* (Inter. and Dry)
2.	*Sitta frontalis* (W. and I.)	*S. castanea* (D.)
3.	*Turdoides somervillei* (I.)	*T. striatus* (D.)
4.	*Otocompsa jocosa* (W. and I.)	*Molpastes cafer* (I. and D.)

These two species overlap throughout most of their range and are only found separately at the two extremes.

	A. Wet Zone	B. Dry Zone
5.	*Iole icterica* (W. and I.)	*Pycnonotus luteolus* (D.)
6.	*Lanius schach* (W. and I.)	*Lanius vittatus* (D.)
9.	*Tephrodornis gularis* (W. and I.)	*T. pondicerianus* (D.)
10.	*Pericrocotus flammeus* (W. and I.)	*P. peregrinus* (D. I. and D.)
11.	*Dicrurus macrocercus* (W. and I. as Winter migrant)	*D. coerulescens* (D.)
12.	*Oriolus oriolus* (W. and I. as Winter migrant)	*O. xanthornus* (D.)
13.	*Aethiopsar fuscus* (W. and I.)	*Acridotheres tristis* (D.)
14.	*Uroloncha striata* (W. and I.)	*U. malabarica* (D.)
15.	*Galerida malabarica* (W. and I.)	*Mirafra affinis* (D.)

Perhaps this is hardly a fair case, as though the two are the representative larks in their respective Zones, their habits are somewhat different.

	A. Wet Zone	B. Dry Zone
16.	*Dryobates hardwickii* (W. and I.)	*D. mahrattensis* (D.)
17.	*Chrysocolaptes guttacristatus* (W. and W. I.)	*C. festivus* (D.)
18.	*Megalaima rubricapilla* (W. and I.)	*M. haemacephala* (D.)
19.	*Psittacula cyanocephala* } (W. and I.)	*P. krameri* } (D.)
20.	*Psittacula columboides*	*P. eupatria*
21.	*Merops orientalis* (Winter—W. and I ; Summer D.)	*M. superciliosus*
22.	*Tockus griseus* (I.)	*T. birostris* (D.)
23.	*Caprimulgus indicus* (W. and I.)	*C. asiaticus* (D.)
24.	*Glaucidium radiatum* (D.)	*Athene brama* (D.)
25.	*Dendrophasa pompadora* (W. and I.)	*Crocopus phoenicopterus* (D.)
26.	*Streptopelia orientalis* } (W. and I.)	*S. senegalensis* } (D.)
27.	*Streptopelia chinensis*	*S. decaocto*
28.	*Cryptoplectron erythrorhynchum* (W. and I.)	*Perdicula asiatica* (D.)

LOCAL MIGRATION

Besides the annual influx of migrants from beyond the northern borders of India, there is a considerable local migration of resident species, generally in an east and west direction. Such insectivorous birds as Swifts and Bee-eaters move down into the Dry Zone after breeding to avoid the heavy rains of the monsoon, while other species, which breed in the Dry Zone, wander up into the Inter and Wet Zones in the dry season.

Apart from these however, there are some half-dozen species, nearly all common Indian plains types, which are extremely numerous all over Coorg in the winter months but which do not breed in the Coorg Dry Zone nor in the adjacent parts of the Mysore Maidan. Where they do breed is a problem which has yet to be solved. A list is appended.

1. *Tchitrea paradisi*	
2. *Dicrurus macrocercus*	*D. coerulescens* is the resident breeding Dry Zone species.
3. *Dicrurus longicaudatus*	
4. *Oriolus oriolus*	*O. xanthornus* is the resident, breeding Dry Zone species
5. *Clamator jacobinus*	
6. *Eudynamis scolopaceus*	May breed in Dry Zone.
7 *Merops orientalis*	Small numbers breed in the Inter. Zone, more in the Dry Zone but nothing like enough to account for the numbers of winter visitors.

SYSTEMATIC LIST

Corvus macrorhynchos: The Jungle Crow.

Widely spread throughout Coorg, occurring chiefly in cultivated country and round towns and villages, but also in deciduous forest as anyone who has been big game shooting will know. They are the first birds to find a carcase, long before the vultures arrive. They nest from January to March. The nests are usually built high and inaccessibly in the outer or topmost branches of a tall tree. One I examined consisted of a rather scanty foundation of large sticks, surmounted by whippy twigs and stout rootlets, with a cup lined with fine rootlets and coir. The latter is a favourite lining material. In the Nilgiris I have seen wool used. In my experience, one bird, presumably the female, does all the building, her mate accompanying her to and fro in the search for materials but not contributing any himself. The same nest is not used twice though a pair will breed in the same locality year after year and there may be a number of old nests in existence together. Four or five eggs are laid, and only one brood seems to be raised. Moulting birds may be seen in August.

Corvus splendens: The House Crow.

Confined entirely to the towns and not numerous there. I have seen them in Fraserpet and Virajpet, elevation 3,000′, but not in Mercara, 4,000′. A solitary pair lived for a long time in Somwarpet, 3,500′, but always appeared much harried and chased by their more numerous and powerful jungle relatives. I have no records of breeding.

Dendrocitta vagabunda: The Tree-pie.

Common and widely-spread throughout Coorg, occurring equally in the Dry Zone, deciduous forest, and Inter-Zone but not in the evergreen forest of the Ghats. It is one of the typical members of the coffee plantation avifauna and is always conspicuous in the mixed flocks which are such a feature of the non-breeding season. The often recorded association of this bird with *Dissemurus paradiseus* is an obvious fact, but as Sálim Ali says in the Travancore Survey, may be simply due to a community of interests. The two species are the largest, noisiest, and most aggressive members of the mixed flocks, and take it upon themselves to act as policemen, being the first to chivy any hawk, owl, mongoose, or snake that appears on the scene. Nevertheless the association does seem to be more than fortuitous, as it continues after the flocks break up, and I have on more than one occasion found the two species nesting in adjoining trees.

In Coorg, March is the usual breeding month. The nests are scanty, flimsy cups of thin twigs built high up in the topmost branches of a tall tree in light woodland. The tree chosen is usually leafless at that time but the nests, though in consequence in full view, are by no means conspicuous owing to their small size.

This bird is quite omnivorous. Fruit, especially various wild figs, nectar from the blossoms of *Bombax* or *Erythrina*, insects large and small, lizards, young birds, or eggs are all equally acceptable.

Dendrocitta leucogastra : The Southern Tree-pie.

Confined to the heavy evergreen forest of the Wet Zone and the *sholas* on the Ghat slopes. Here it replaces the last bird, but is never common. It is as noisy as its relative but lacks the mellow, metallic, fluty notes of the latter. I have not found a nest though it undoubtedly breeds in Coorg.

Parus major : The Grey Tit.

Very rare in Coorg. I noted this bird in my original 'Notes on the Birds of Coorg' (*J.B.N.H.S.* 1928) as being fairly common in Pollibetta, but this was incorrect. The only place I have actually met it is in the Dry-Inter deciduous forest of the eastern ridge, at Sige Hosur on the edge of the Dry Zone. It occurs again over the border in the Mysore Maidan. This restriction to dry biotopes is remarkable considering that it is very common at high elevations in the Nilgiris in the moist, evergreen *sholas* on the plateau. I have not found the nest in Coorg. In the Nilgiris and Ceylon holes in stone walls are commonly used.

Machlolophus xanthogenys : The Yellow-cheeked Tit.

Typically a bird of the coffee plantations of the Inter-Zone, neither extending into the Dry Zone, nor to the higher elevations of the Ghats, though it is to be found in Moist-Inter forest. In the Nilgiris they are common up to 4,500′ above which height they are replaced by the last species. They live in family parties throughout most of the year, and are constant members of the mixed flocks. They are typical tits in their ways but are strictly confined to woodland country. One used to roost regularly in a hole in a branch of a tree in my garden. The only nest I have examined was found on 11th October in an old barbet hole eight feet up in a tree stump in a coffee clearing ; it contained fully-fledged young. The nest was a compact pad of felted bark, fibres, and hair. I saw the young being fed on cockroaches, grubs, and a large green caterpillar. Other nests I have marked have been in inaccessible sites in old Coppersmith holes high up in dead and rotten trees. My only clutch record is three.

Sitta castanea : The Chestnut-bellied Nuthatch.

Scarce and more or less restricted to the Dry Zone round Hebbale. Strangely enough I have once seen one in my garden in the Inter-Zone. It was in company with a *S. frontalis* at the time so that there was no doubt of the identification. I have not found the nest.

Sitta frontalis : The Velvet-fronted Blue Nuthatch.

A very common bird in coffee in the Inter-Zone, an invariable member of the mixed flocks. It is also found on the Ghats up to the highest *sholas*, and regularly if less commonly in the deciduous forest belt. I have not actually found a nest, but I saw a bird flying about with a feather in its bill on March 29th, and saw a pair on Jan. 21st both collecting down from seeding weeds growing on a fallen log. Judging by the appearance of young birds, breeding extends from January to April.

Garrulax delesserti: The Wynaad Laughing-Thrush.

Confined to the heavy evergreen jungle of the Western Ghats. I have only come on them in deep, virgin forest at elevations ranging from 1,000′ on the Iritti Ghat to 5,000′ in the belt of *Wate* bamboo, which grows at that height on the upper slopes of Pushpagiri. They live in very large flocks of 40 or 50 birds, whose noisy calls may be heard at a great distance. They are very tame and inquisitive and are extremely sociable, four or five frequently perching on the same twig and preening each other's feathers. I have no breeding notes.

Trochalopteron jerdoni : Banasore Laughing-Thrush.

Recorded from the Coorg and Wynaad Hills in the New Fauna. Davidson is reported to have obtained it in the Brahmagiri Hills in the south of the Province. It seems most improbable that this species should occur so far north, cut off by *T. cachinnans* in the Nilgiris from its other races. One might well expect to find *T. cachinnans* as its favourite *Rubus* facies exists in quantity on the higher Ghats, but it does not occur.

Turdoides somervillei : The Jungle Babbler.

A common bird in the deciduous forest belt especially among bamboo, and on the outskirts and clearings. It occurs frequently, but apparently rather as a stray in the coffee and *Lantana* and parkland typical of the Inter-Zone. It is found in flocks of up to a dozen usually travelling in company with other species. They feed mostly on the ground, scuffling noisily among the dead leaves, the individuals playing follow-my-leader through the undergrowth, only appearing at the tops of the bushes to take flight to a new feeding ground. They do not penetrate into the Wet Zone of the Ghats nor are they found above about 4,000′. Their place here is taken by *Argya subrufa*, but though the ranges of the two species overlap, they do not intermingle. On the other border however, where they meet *Turdoides striatus*, both species associate freely. The only nest I have seen was found on April 20th four feet from the ground in a coffee bush. It was a rough cup of coarse grass and roots, and could hardly be said to have been lined though perhaps the innermost grass was finer in texture. There were two unincubated eggs.

Turdoides striatus : The White-headed Babbler.

This species takes the place of the last in the Dry Zone scrub country. Its habits are in every way similar to those of *T. somervillei*. It is abundant wherever there is thick scrub jungle and *Lantana* brakes, and is extremely noisy, and assiduous in mobbing and abusing any hawk, owl, or beast of prey that it finds on the move. A nest was found on May 25th, seven feet up and well-concealed in a small, creeper-grown thorn-tree in thorny scrub jungle on a rocky ridge. It was the usual large, loose cup of dried grass and contained two eggs, quite fresh, and probably not a full clutch.

Argya subrufa : The Rufous Babbler.

A bird mainly of the evergreen *sholas* of the Ghats. Sálim Ali apparently met it only up to 3,500′, but in Coorg it is more common above 4,000′ than below, and I have seen it up to the highest summits. It prefers a facies where long grass is intermixed with the scrub and trees, and abandoned paddy fields are a very favourite haunt. In one such, on the estate on which I lived, a flock could always be found during the seven years I was there, and never seemed to wander far away. They are even greater skulkers than *T. somervillei* and just as noisy. They appear to be monsoon breeders. I caught a newly flown juvenile in the Nilgiris on Sept. 1st and found a nest with young ready to fly in Coorg on August 13th. This was in a small bush in a little clearing in the thick secondary vegetation growing in a sandalwood plantation. The old birds were noisily demonstrative, giving away the site by their abuse. The nest, with other old ones which I have seen, was quite distinctive, being a large, very loosely-knit cup made entirely of the twisted stems and tendrils of honeysuckle or some similar creeper, with an apology for a lining consisting of a few rootlets.

Pomatorhinus horsfieldii : Horsfield's Scimitar Babbler.

This bird occurs throughout Coorg, though nowhere in great numbers, from the highest Ghat *sholas* to the scrub jungle of the Dry Zone. It is probable that both the typical race and *travancoriensis* inhabit the Province but this remains to be proved. They are usually seen in pairs, sometimes alone, but more often in the mixed flocks. They are more arboreal than the preceding babblers, and their favourite feeding grounds are the mossy limbs of forest trees, along which they work, probing the crevices with their long, curved bills. They appear to breed in the cold weather. I have twice found the nest. One on Dec. 21st was a loose ball of dead leaves which fell apart at a touch, placed in full view on the upper surface of a coffee bush two feet high. There were two fresh eggs. The other, containing a chick about four days old and an addled egg on Jan. 10th, was in the Dry Zone at the foot of a lantana bush on the steep slope of a rocky ridge. The thorny runners hung down and protected the nest, which was nothing more than a domed ball excavated out of the tangle of dead leaves and grass lying against the bank. The entrance was woven of dry grass with a slight platform of the same material in front. When feeding and unexcited their note is a low, croaking chuckle, but under stress of emotion they burst into a whirring call terminating in a series of mellow '*wok*, *wok*, *wok*'s.

Dumetia hyperythra [albigularis]: The Small White-throated Babbler.

In Coorg I have only met this bird in thorny scrub and grass jungle in the Dry Zone at about 3,000′. They do not occur or are rare in the Inter-Zone and the Ghat slopes, though on the Nilgiris I found them common on the edges of *sholas*, and have found a nest at 5,000′. They are typical little babblers in their ways, wandering through the undergrowth in small flocks, keeping in touch with low calls not unlike those of *Rhopocichla.*

My Nilgiri nest was on the ground on the banks of a watercourse running through elephant grass and dwarf date palms. It was cunningly concealed under the fronds of a date, and was a neat ball woven of dry date leaves and grass without lining, and with the entrance at one side. There were two fresh eggs on 21st May.

Chrysomma sinensis: The Yellow-eyed Babbler.

Confined as far as Coorg is concerned to the Dry Zone where it is not uncommon in open, scrub-grown wasteland. A skulker like most babblers, it is usually seen in small flocks, but occasionally singly or in pairs. It has a sweet and quite powerful song. I found a nest which I believe was attributable to this species in a *Butea frondosa* sapling, two feet from the ground, on June 14th. It was a deep and well-built, conical, cup of grass-blades so thickly bound with cobweb that it was almost white in colour.

Pellorneum ruficeps: The Spotted Babbler.

Very common in the Inter-Zone and the Ghat *sholas*, and less numerous in the Dry Zone, though I have found it breeding there. It is partial to coffee cultivation but is seldom seen, being the most confirmed skulker of the clan. Its sweet call note—'*pee*, *pee*, *peeea*'— is a very common bird sound at certain times of the year, and besides this it has in the breeding season a song, quite distinct from the call, but of the same timbre. Except when nesting it is seen in small flocks which keep entirely to the undergrowth and find most of their food on the ground. I have found nests from the end of February to April. They were all in very similar situations, in drifts of dry leaves at the foot of bamboo clumps or lantana bushes, and were very flimsy, domed affairs, made of the surrounding dry leaves, with the exception of one which was of grass. The cup is sunk below the outer level and lined with grass. Two eggs form the clutch.

Alcippe poioicephala: The Quaker Babbler.

One of the commonest birds in the Ghat *sholas* and evergreen forest up to 5,000′. It is fairly numerous in coffee in the Inter-Zone, and wanders into the Deciduous Forest, especially along ravines with strips of evergreen growth along their slopes. It occurs in larger flocks than the last species and is more arboreal, but keeps to the interior of the woods, seldom venturing into the open or flying far. Tall *Strobilanthes* undergrowth is what it loves above all. It has a number of churring and chattering call notes. The song, often heard in the first half of the year, consists of four sweet notes, not unlike those of the Spotted Babbler. Nests I have found have all been built in the undergrowth of evergreen *sholas*. They were in small, isolated shrubs, three or four feet from the ground, and were quite conspicuous. They were substantially, though roughly-built cups of green moss, lined with black rhizomes. Two eggs form the clutch. Nesting mostly takes place from February till April but I once saw a newly-fledged juvenile in August so that the season probably extends throughout the monsoon.

Rhopocichla atriceps: The Black-headed Babbler.

Very common wherever evergreen forest occurs up to the highest elevations, and to be found even in the small patches of evergreen growing along ravines in the deciduous forest. Plenty of undergrowth; *Strobilanthes*, rattans or young trees are essential to their requirements, and cardamom cultivation is a very favourite resort. They are not arboreal birds, and seldom venture more than a foot or two above the ground, skulking through the undergrowth in considerable flocks of a dozen or more. Normally they are very quiet but on being alarmed set up a tremendous 'churring', audible at a considerable distance. They have a passion for nest-building and in any of their normal haunts one will probably find a nest every hundred yards or so at any time of year. They are very rough balls of dead leaves six to eight inches in diameter which fall to pieces at a touch, jammed into a fork of a shrub at two or three feet from the ground, and without lining. These nests are not used for breeding, though the birds certainly roost in them at times, if not regularly. The real nests are similar in design but much more carefully built, and lined with black rhizomes and grass. They are very well hidden in thick herbage within a couple of feet from the ground, often on the edge of a *shola*, whereas the 'cock' nests are usually inside. One exceptional one I have seen was quite as roughly built as a 'cock' nest but lined. There appear to be two breeding seasons, before and after the monsoon. Nests found with eggs in March, April and again in September. The usual clutch is two eggs.

Aegithina tiphia: The Iora.

Common all over Coorg except on the higher hills of the Ghats, but most numerous in the Inter and Dry Zones. Parkland, orchards, and open, cultivated country are preferred to forest. Common and brightly coloured as it is, it is a bird which is heard more often than seen, as it keeps much to the tree-tops where the green and yellow of its plumage blends with the leaves. It usually goes about in pairs which are almost invariable members of the mixed flocks. In the breeding season, the cock has a pretty display, flying up vertically for a few feet, and descending with wings and tail outspread and all his feathers fluffed out, especially those of the white rump, till he looks like a little ball. The nesting season appears to be extended but the nests are hard to find. April and May seem to be the chief months, but I have found one in August. They are beautifully made, shallow cups not more than two and a half inches in diameter, built of shreds of bark so covered externally with cobweb as to be almost white in colour, and lined with a little grass. I have seen them four feet up in a coffee bush, or thirty feet up in a big fig tree. They are slung in a horizontal fork of an outlying twig. Both birds assist in building and brooding, but in one case which I watched, the cock did not feed the young himself, but handed over the green caterpillars which he brought to the hen for distribution.

The Iora is the favourite host in Coorg for the Banded Bay Cuckoo.

Chloropsis aurifrons: The Gold-fronted Chloropsis.

Common throughout the Inter-Zone and the lower slopes of the Ghats, and extends into the deciduous forest. It is a noisy bird, and owing to its green colour and its fondness for thick evergreen tree-tops, it is far more often heard than seen. Flowering trees in blossom particularly *Bombax*, *Erythrina*, and *Acrocarpus* are a certain attraction. One or two pairs can usually be seen in any of the mixed flocks. The song is an extraordinarily loud and voluble rattle, and the bird is an excellent mimic, introducing the calls of all sorts of other birds with remarkable verisimilitude. I have never been able to find a nest, but the season is probably prolonged as juveniles in immature plumage may be seen both before and after the monsoon.

Chloropsis jerdoni: Jerdon's Chloropsis.

Occurs, but without considerable collecting it will be difficult to determine its status as it is so similar in habits and field appearance to the last species. I suspect however, as remarked by Sálim Ali in the Travancore Survey, that it tends to replace *C. aurifrons* in the Dry-Inter and Dry Zones.

Microscelis psaroides: The Black Bulbul.

Very common in the hill *sholas* above 4,000′. It is a great wanderer in the cold weather, and may then be found in large, noisy flocks in the Inter-Zone, especially where there are any nectar-bearing trees in flower. In the Nilgiris I found that they mostly left the very wet western face at the onset of the S. W. monsoon after breeding. The flocks follow each other from tree to tree with harsh grating calls, and they are entirely arboreal, never coming near the ground. Their food seems to be chiefly berries of various sorts and nectar when obtainable. Breeding takes place from March to May, the favourite localities being the edges of *sholas* from 4,500′ upwards, where the trees become stunted and thin out into the grass downs of the tops. The nest is a neat cup of green moss lined with grass. It is very shallow, and small for the size of the bird, and is placed in an outlying horizontal fork of a small, moss-grown tree at ten to fifteen feet from the ground, being far from easy to spot. The usual clutch is two.

Molpastes cafer: The Red-vented Bulbul.

The distribution of this species in relation to *Otocompsa jocosa* is rather peculiar. In the Dry Zone scrubland, *M. cafer* is the predominant species, though *O. jocosa* occurs. Throughout most of the Inter-Zone both species are common with *O. jocosa* predominant. In the Wet Zone evergreen above 4,000′, *O. jocosa* is found alone. Yet in the Pollibetta district, *c.* 3,000′, Inter tending to Dry-Inter, *O. jocosa* is very numerous, and *M. cafer* scarce, while round Mercara, *c.* 4,000′, wet evergreen, *M. cafer* abounds.

Fairly open country is its main requirement. It is usually seen in pairs throughout the year. Fruit and berries are the principal food, but numbers of insects are consumed especially when there are young to be fed, and they take part eagerly in the general crusade against the emerging swarms of termites at the beginning of the rains.

The nest is usually built higher up than that of *O. jocosa*, and though similar to that of the latter, can be recognised with a little practice. A favourite site is at the end of a pollarded branch of an isolated tree, concealed in a tuft of leaves. A solid foundation is preferred and the nest is seldom built in a bush or at the end of slender twigs. The most unusual site I have seen was on a verandah rafter of a bungalow. It is often well hidden, but I have found nests in leafless trees, visible at a great distance. Fine twigs and midribs of dead leaves are woven into a neat cup, lightly bound on the outside with cobweb, and lined with grass. Two, and less commonly three eggs form the clutch. Breeding goes on through most of the year with peak periods in March/April and again in September.

Otocompsa jocosa: The Red-whiskered Bulbul.

One of the commonest birds of Coorg from the highest to the lowest elevations only absent from the Interior of the Wet Zone Forests and becoming scarce in the Dry Zone scrub. It is one of those species that appear to flourish solely through their omnivorousness, adaptability and fecundity. It is on the whole chiefly a berry eater, but all kinds of insects are grist to its mill, and much damage is done in gardens among young peas and seedlings. The nests may be built anywhere, seldom at any great height and sometimes almost on the ground. They are sometimes well-concealed, but frequently are very conspicuously placed in some small isolated bush, and the bird who is a close sitter gives the site away by her agitated departure at the last moment. It is safe to say that any seasons's birds-nesting will yield as many nests of this species as of all other birds put together.

Being so accessible and easily found, the casualties are enormous, but the birds breed steadily throughout the year and seem to have no difficulty in making up for the losses. The nest is a fairly neat cup, flimsily built of fine twigs and dead leaves, and lined with grass. I have seen one lined with hair. It is placed in any sort of small bush. The clutch is two, less commonly three.

The young when first hatched are fed entirely on insects but as they grow older, berries are brought to them. These bulbuls are regular members of the mixed flocks, usually in pairs, but occasionally loose parties of twenty or more may be seen. The jaunty black crest is always carried erect except when in flight or brooding.

Iole icterica: The Yellow-browed Bulbul.

A forest species, very common through the wetter, well-wooded parts of the province. It does not however ascend much above 4,500′.

and despite Mr. Sálim Ali's remark in the Travancore Survey, I found that this was usually its definite limit in the Nilgiris, though wanderers may go higher for short periods. It extends into the deciduous forest wherever there is a certain amount of evergreen vegetation along rivers and damp ravines. It does not care for cultivation though a fair number visit coffee plantations if there is forest close at hand, and I have found them breeding there. They are arboreal birds, noisy and cheerful, with a variety of loud, mellow notes. They are mainly frugivorous, and like all bulbuls are very fond of nectar. Breeding takes place mostly in Feb./March extending to May. The nest is quite unlike that of other members of the family. The usual site is in a thinly-foliaged, isolated shrub in the interior of light forest. In most cases it is within five feet of the ground, though an exceptional one was built in my garden at the end of a bough in a tall tree at fifteen feet. It is a slightly built hammock of grass and skeleton leaves, slung in a horizontal fork with a certain amount of cobwebs and green moss on the exterior, and lined with grass or black rhizomes, and looks very much like a large White-eye's nest. The normal clutch is two. I confirm Sálim Ali's note that the young do not resemble the adults. They are a general dull brown all over the upper parts, head, and breast and lack the general yellowish tinge of the adults. The only yellow is on the flanks.

Pycnonotus gularis : The Ruby-throated Bulbul.

A common species throughout much of Coorg. It is definitely a forest bird, avoiding all forms of cultivation, even coffee, but in spite of this is far from shy. While found in deciduous forest, it prefers evergreen, and extends from the foot of the Ghats up to 4,000′, seldom higher. Its most favourite haunt is the mixed stand of bamboo and evergreen on the borders of the wet and Inter-Zones. It is usually seen in pairs which keep in touch with a low, constantly uttered call-note, and in addition it has a sweet, tinkling song. It is a tree-living species, finding most of its food in the forest canopy, feeding on a variety of fruit and insects. Lantana berries are largely eaten. I have found nests from the end of February to early April. The favourite site is on the edge of a patch of evergreen jungle. They are from ten to twenty feet up in a thick-foliaged tree, often covered in creepers. From below they are almost impossible to detect, as they are very small and consist of a few large, yellow, dead leaves bound lightly with cobweb, and look just like a casual, wind-blown accumulation of rubbish. The rim is bound with grass stalks and there is a slight lining of grass. Two has been the clutch in all nests I have seen.

Pycnonotus luteolus : The White-browed Bulbul.

A bird of dry, open country and scrub jungle. It is common in the Dry Zone, and also occurs in the Inter-Zone in the patches of '*bane*' land, grazing ground with short grass and scattered clumps of lantana and small trees, which are to be found particularly in the north of the province. It avoids continuous forest of any kind, and will not be found above 3,500′. It is as arrant a skulker as any babbler, and is usually seen in pairs or singly, never in flocks. It keeps entirely to the interior of the scrub thickets, only emerging from one brake to make a quick dash across to another. Were it not for its loud call, a rattling succession of five or six notes, its presence would go undetected. The nest is not easy to find as the birds are so shy, and avoid showing themselves in the vicinity. The only two I have come across were built in January and March respectively. One was in a small, scantily-leaved bush in undergrowth under a clump of trees; the other in an isolated thorn bush in a patch of lantana scrub. Both were within three feet of the ground and might have been taken for those of *O. jocosa*, but were even more untidily and loosely-built with very little cobweb in the construction.

Microtarsus poioicephalus: The Grey-headed Bulbul.

This species is confined to heavy evergreen forest, especially along the banks of rivers, or swampy ground where the trees are overgrown with lianas and rattan. It occurs on the Ghats from sea-level up to about 3,500′, and is found in the Moist Inter-Zone wherever suitable facies exist, but avoids cultivation with the possible exception of cardamom *sholas.* It is decidedly local, but where found at all is usually numerous. The pairs or small parties keep to the tops of tall, thick-foliaged trees and so are not easy to watch. The call is a very characteristic, sharp, finch-like, double '*chink, chink*'. A noticeable field characteristic is the width of the tail which is cut very square at the tip. They feed largely on berries often in company with *P. gularis* and *I. icterica.* I have only found the nest once, on 13 March. It was in a shady ravine in a plant of the *Strobilānthes* which formed the undergrowth beneath the tall evergreen forest. It was a rough, shallow cup of dead grass and rootlets lined with the latter, balanced on a leaf and bound to the main stem with cobweb so loosely that it looked as if it would overbalance at any minute. The solitary hardset egg, though of bulbul type, was quite distinctive and could not have been mistaken for that of any other species.

Brachypteryx major: The Rufous-bellied Shortwing.

So far only recorded, as far as Coorg is concerned, by Davison from the Brahmagiris on the extreme southern border of the Province. As however Sálim Ali has now found it on the Bababudans in N. Mysore, it probably occurs in small numbers at high elevations all along the Ghats though I have never come across it myself. In the Nilgiris it is common and I have found a number of nests. The birds very much resemble the White-bellied Flycatcher (*Muscicapula pallipes*) in habits. They haunt the interior of dark *sholas*, lurking in the undergrowth and seldom showing in the open. They have a sweet, but low, warbling song usually only heard at dusk. They are late breeders, most nests being found in May when the rains have broken. Rather surprisingly, considering their retiring nature, they frequently build in quite conspicuous places. A favourite site is a perpendicular cutting at the side of a path running through a *shola.* The nest is a large, loose mass of green moss wedged into a hollow in the bank, the shallow cup being lined with black rhizomes. Where the bank is moss-grown it is not easily seen, but when, as often happens, a bare earth face is chosen, it is visible at some distance. I have also found nests on a broken tree stump, and in a hollow in the stem of a big tree. The usual clutch is two.

Tarsiger brunnea: The Indian Blue-chat.

A common winter-migrant throughout Coorg, except, I think, in the Dry Zone. They arrive in a wave about the third week in October (dates over ten years Oct. 15th–27th), and for a few days their song may be heard in every thicket. It is a loud '*peep, peep*', followed by a tumbled jumble of four or five other notes. It is uttered suddenly and surprisingly, and the bird then remains silent, save for an occasional low '*tck, tck*', as it feeds. After a week or so numbers decrease presumably owing to the departure of birds wintering further south. The song is seldom heard after Christmas, and the birds remain silent until their departure. They are the most arrant skulkers, keeping to the ground in the heart of impenetrable thickets, and it is very hard even to catch a glimpse of them. They have a habit of flirting the tail like a Redstart.

Saxicola caprata : The Pied Bush-chat.

A widespread resident in Coorg. It is common in the Dry Zone and occurs throughout the Inter-Zone, where however it is more or less confined to paddy fields. It does not occur on the downs at high-elevations on the hills, a biotope so popular with the Nilgiri sub-species. It is a highly territorial bird throughout the year, each pair claiming an extensive range in which no trespassers are allowed, and there will seldom be more than one or two pairs in any one stretch of paddy fields. In the Dry Zone however where their range overlaps that of *Saxicoloides fulicata*, the two species may be found in occupation of the same area, despite both having similar habits and a highly developed sense of property.

Nesting begins about the end of March, a favourite site being a paddy-bund. The nest is tucked into some hole or crevice in a bank, and is a small cup of grass, lined with rootlets and hair. In front there is usually a small platform of dead leaves or grass. It is well-concealed but the position is given away by the birds. The hen slips off quietly at the first sign of danger, but both remain in the near vicinity scolding angrily until the intruder is past. The hen does all the nest-building, but both parents feed the young. The male has a sweet little song, uttered as he springs in the air and returns to his perch. I have heard them singing on bright moonlight nights, long before dawn. In display, the male crouches on the ground before his mate, singing loudly, wings and tail spread to expose to full advantage the white rump and wing patches. The food consists of insects caught by darting from a perch to the ground or into the air.

Saxicola torquata: The Stone-chat.

A fairly common winter migrant in the Mysore 'Maidan'. I have only once seen one in Coorg, in a paddy field near Fraserpet, in the Dry Zone.

Phoenicurus ochruros : The Indian Redstart.

A moderately common winter migrant in the Mysore 'Maidan'. I have seen them at Hunsur and Peripatnam and twice in the Coorg Dry Zone near the Mysore boundary. Open, stony, scrub jungle seems to be their favourite haunt.

Cyanosylvia svecica : The Bluethroat.

A fairly common winter migrant in Mysore where it is found along the reedy margins of half-dried tanks. They flit about among the reeds in a robin-like manner, but are silent, and I have never heard them utter a sound. The only record which I have for Coorg was a solitary seen on the banks of the Cauvery at Ramasamy Kanave in the Dry Zone, only a few yards from the Mysore border.

Saxicoloides fulicata: The Indian Robin.

Confined strictly to the driest part of the province at 2,500′/3,000′ where it is common in the thin, stony scrub jungle, and to a less extent in cultivation. It is very like the Bush-chat in habits. The birds remain paired and maintain their breeding territory throughout the year. They are more terrestrial than the Bush-chat, obtaining most of their food by hopping actively about on the ground with the long tail carried cocked high, and in moments of excitement, almost touching the back of the head. The song is a loud, short, sweet tangle of notes uttered from the ground or a low perch. Nesting begins as soon as the first spring showers give the vegetation a start. April and May are the principal breeding months. The nests are shallow cups of grass, lined with hair, and are placed in a variety of situations, but usually on the ground in a hollow in a bank or under a stone. I once found one in a thornbush, two feet up, which might have been mistaken for a bulbul's nest. They may be well-concealed or quite open. Nests I found at Secunderabad nearly all contained a piece of snakeskin in the construction, but I have not noticed this in Coorg. The cock shares in the work of feeding the chicks who are covered in blackish down. Three is the normal clutch.

Copsychus saularis: The Magpie Robin.

Common throughout most of Coorg, but does not occur on the Ghats or in evergreen forest, and is less common in the Dry Zone. Its favourite haunts are the '*bane*' lands round villages, open grazing among scattered trees which are constantly pollarded for firewood and provide numerous breeding sites in the decaying stubs. Being a highly territorial species it is rather thinly distributed, each pair occupying a considerable area. My garden used to constitute two territories. In the winter, both pairs came to feed amicably on the crumbs from my tea-table, but during the breeding season there was continual bickering. The cocks come into full song in January, being particularly vocal at dawn and dusk. In the presence of the female, they become quite possessed, bowing with the body quivering all over, the tail cocked right over the back, and singing as if their lungs would burst. On one occasion I saw two males locked in combat on the ground, while the female hopped round them singing lustily herself though not as loudly as the males do. Most of their food is obtained on the ground, and consists of insects. I have seen one attack and kill a young mouse.

In Coorg nesting takes place from February on until the rains, with occasional post-monsoon broods. In Ceylon, a pair which lived in the roof of my bungalow, raised a succession of at least three broods between April and August. When flown they all used to roost together on a limb of a cypress in the garden until the hen began to sit again, and it was only when the next brood were hatched that the last ones were finally driven out of the area.

Though the roof of a building may be chosen for a nesting site, the favour to position is a hole in a tree, either natural or the old boring of a woodpecker or barbet. It is usually at a considerable height from the ground, though I once found one in a fence post at four feet. The female does all the building, which merely consists of making an exiguous cup of rootlets and the midribs of dead leaves at the bottom of the hollow. There are usually three eggs. In the first juvenile plumage, the head and body are mottled brown, only the wings and tail showing the black and white of the adult. I have seen a completely albino specimen.

Copsychus malabarica: The Shama.

The range of this species is strictly limited to the bamboo facies of the deciduous forest belt. Here it is not uncommon though far from conspicuous as it is shy, usually silent, and decidedly crepuscular in habit. It has the sweetest voice of any bird in S. India, and it is only a pity that it makes such little use of it. The song may most often be heard at dusk. A few spasmodic fluty notes of singular richness, reminiscent of the best efforts of the Nightingale, are followed by several minutes' silence, and then repeated as the bird moves about in the interior of a bamboo clump. They feed mostly on the ground and among the undergrowth, seldom ascending high into the trees. They are in song from February onwards until well into the monsoon. I have never found a nest in Coorg, but once saw a pair with newly-flown young in June. As with *C. saularis*, the juveniles are mottled brown over the head and body but show the white rump, long black tail, and black and white wings of the adult. A nest I found in Assam in March was just like that of *C. saularis* in a hole in a tree stump, three feet from the ground in mixed forest. There were three young. When the nest was approached, the parents uttered a loud alarm note like the creaking of two branches rubbing together in a wind.

Turdus simillimus: The Blackbird.

A blackbird of some subspecies is resident on the Ghats from their summits down to about 4,000′. It is to be met with throughout the year in all the *sholas* and in the interior of evergreen forest, but is decidedly shy. I have only found old nests but like the Nilgiri bird they probably breed during the monsoon when their haunts are difficult of access. During the cold weather from October to March, blackbirds are common in the Inter-Zone specially in the coffee plantations in small parties. Whether these are migrants from the north or have merely moved downhill for the winter, I do not know, but I suspect the latter, as a male I shot was identified as subsp. *simillimus.* The winter flocks in the coffee feed on the ground among the dead leaves, flying up into the trees with a squawk of alarm if disturbed. I have seen them feeding on nectar from the blossoms of *Erythrina* trees.

On the Nilgiris the blackbird is very common, particularly so in small *sholas* and patches of cover along streams out on the open downs. Nesting begins in March, but is at its height after the onset of the rains, and the males are in song all through the monsoon. I found many nests there. A few were in evergreen shrubs and in these cases were substantial cups of moss, grass and lichen with an outer lining of mud and an inner one of grass. The great majority, however, were on ledges or cracks in banks where the earth had been laid bare by a slip, and in such sites were often mere cups of mud lined with grass with a little moss and lichen building up the front. The clutch is two, occasionally three.

In Ceylon the local subspecies is one of the few birds really at home in tea cultivation. The nests are usually well-concealed in the crowns of pollarded *Grevillea* trees, but may sometimes be found completely in the open in a fork in one of the sparsely-leaved *Erythrinas* grown for green manure.

Oreocincla dauma : The Nilgiri Thrush.

I have never seen this bird in Coorg myself though it may easily occur in the higher Ghat forests as it is such a shy dweller in the deepest woodland that it can easily be missed. On the other hand since the Mysore Survey only records it from the Billigiris, it may well be another of those high-level species which do not extend further north than those hills.

Geokichla wardi : The Pied Ground-thrush.

Never seen in Coorg, and only once in the Nilgiris, where I came across two males at 4,500′ in the Ochterlony Valley in forest on Feb. 28th.

Geokichla citrina cyanotus : The White-throated Ground-thrush.

This very well-marked resident race seems almost worthy of specific rank. It is a bird of medium elevations, and is numerous all through the Inter-Zone. It does not occur on the Ghats much above 4,000′, but extends through the deciduous forest belt in lessening numbers as the rainfall diminishes to its limit on the edge of the Dry Zone proper. Fairly open, well-wooded country suits it best, particularly coffee cultivation. It has a typical thrush song, first heard in February, loud, sweet and very variable. The bird sings from a perch well up in a tree. In fact the trivial name is a bad one, for though they obtain most of their food on the ground, they are otherwise largely arboreal. The male has a peculiar display, standing very erect and rigid on a bough beside his mate with the head bent stiffly and tucked into the breast feathers as he sings vigorously. Breeding starts late, seldom before the beginning of May by which time there has been a certain amount of rain, and the ground is softening, and earthworms are obtainable. It continues all through the monsoon up to September. The nests are substantial cups of moss, roots, and wood pulp, and often a certain amount of mud, with a lining of rootlets and leaf stems. They may be found in a variety of situations from thirty or forty feet up on a horizontal fork of a tall tree, to a crotch of a sapling or coffee bush within four feet of the ground. Wherever it is they prefer an open situation to one in the interior of a bush, and the lower nests are in consequence extremely conspicuous, and casualties are very high indeed. They often choose the *Erythrina lithosperma* saplings in young coffee clearings. One pair which I had under observation made unsuccessful attempts to breed four times in different saplings over an area of fifty square yards. I was able to follow one breeding cycle right through. The hen was extremely bold while brooding, the cock who did not seem to take his share in this work was much shyer. As soon as the young hatched, both parents fed them, largely on earthworms. It was noticeable that while the hen used to brood for a short spell after each feed, the cock merely fed the young, swallowed any faeces that were passed and went straight off. After the fifth day, the faeces were no longer eaten, but simply removed and dropped over the side of the nest. The incubation period was 13/14 days, and the young flew on the 12th day from hatching. In order to get some more photographs, I tethered one on the ground. The parents came to feed it and still removed the droppings though it was out of the nest.

After the beginning of October, the birds become very shy and are seldom seen, keeping to the ground and the undergrowth. Their numbers seem so reduced that I suspect that many migrate elsewhere during the winter months.

Monticola cinclorhyncha: The Blue-headed Rock-thrush.

A common winter migrant throughout the Inter-Zone of Coorg, particularly partial to coffee plantations. During its stay, it is to be found mostly in woodland of a fairly light nature, and is almost exclusively arboreal, living in the trees and finding most of its food there in the form of insects picked off the trunks and branches. It is of a solitary disposition as regards its own species but may sometimes be seen accompanying the mixed flocks. The average date of arrival over ten years has been Oct. 17th and it leaves about the end of March. I have never heard it singing, but it has a peculiar grating call note, seldom uttered.

Monticola solitaria: The Blue Rock-thrush.

A regular winter migrant but not nearly so numerous as the last. It will be found singly on any of the more craggy peaks of the Ghats up to the highest elevations, keeping to bare sheets of slab rock, where it feeds on insects caught in the crevices and under boulders. Occasionally a bird will adopt a building in otherwise unsuitable country. I have twice known one spend a whole winter on or in the close proximity of a coffee store with its adjacent cement drying floors, roosting under the eaves and taking shelter there when alarmed, and never going more than fifty yards away. I saw one of these dealing with a large centipede, three or four inches long. It was beating it on a stone to subdue it. They come in about the middle of October and leave in March.

Myiophoneus horsfieldii: The Whistling Thrush.

Common in the rain forest on the western slopes of the Ghats from sea-level up to 4,000′ or more. It occurs sparingly through the Inter-Zone wherever there are permanent, swift-running, rocky streams. It is essentially a waterside bird, and demands rocks, rapids and shady evergreen jungle. Slow, sandy or muddy rivers are of no use to it. It is sedentary, each pair occupying the same territory year after year, and building on the same site, often on the foundations of an old nest. Except in the breeding season they are shy and silent, hunting their food in the stream bed or in the undergrowth on the banks, the only sound uttered being a loud, single call note. From April onwards the males begin their sweet, loud song, a few rich notes wandering aimlessly up and down the scale for all the world like a boy whistling at random.

It is most often heard at dawn and dusk. Breeding does not start until the rains have well broken and the streams are coming down in spate. It goes on from May to August in the height of the monsoon. The nest is usually placed on some rocky ledge beside a waterfall or rapid, often in a spot continually soaked in spray. At times however they will nest in the rafters of a building, such as a mill or pulphouse on the river bank. The nest is a very bulky and solid cup of moss, often plastered in place with a foundation of mud especially when built on a sloping ledge. The lining is of roots, and the clutch numbers two or three. Two broods are often reared in the same nest without rebuilding.

Muscicapa parva: The Red-breasted Flycatcher.

A widely-spread and fairly numerous winter visitor over most of Coorg. I have noticed it most often in coffee cultivation but any fairly well-wooded country suits it. I have never seen one with even a suggestion of red on the breast. The most distinctive feature is the partially white outer tail feathers which are displayed when the bird spreads its tail and cocks it over its back, a constant habit while perching. It is a typical flycatcher in its ways, flying out from a perch to catch insects on the wing, or not infrequently on the ground, and constantly uttering its call note, a low '*tck, tck*'. It is seen singly and is a late arrival appearing in the last week of October.

Muscicapula pallipes: The White-bellied Blue Flycatcher.

Not uncommon at medium elevations up to 4,500′. It is typically a bird of dense evergreen forest, where it flits unobtrusively among the undergrowth and lower trees. Its quiet and retiring habits make it seem rarer than it is. It does not often come into cultivation but I have seen it on several occasions in the bamboo jungle of the Inter-Zone well out of its normal range. It is a sluggish little bird, seldom catching insects on the wing, but working through the thickets or dropping to the ground, constantly twisting and fanning its tail. The call note is a low, *tsk, tsk*, and the male has a sweet little song of a few notes uttered in a quiet, contemplative manner. I have not found the nest, but saw a pair feeding newly flown young at the end of June, so that it is probably a monsoon breeder.

Muscicapula rubeculoides: The Blue-throated Flycatcher.

This species must occur in Coorg, as it is recorded as common by the Surveys both of Travancore and Mysore. I can only assume that as it is not noted in the Fauna as being a S. Indian bird, I was not on the look-out for it, and must have failed to distinguish it from *M. tickelliae*. In view of this and Sálim Ali's discovery of *M. superciliaris* in Mysore, any worker in the south will be well-advised to pay particular attention to the Blue Flycatchers, especially in winter, as it is possible that more of the N. Indian species migrate south than are suspected. On one occasion I had an excellent view of a typical *Muscicapula* which I was unable to place. The upper parts were dark, slatey blue, lores and cheeks black, a conspicuous but narrow white supercilium, throat, breast, and underparts rufous. The only species which at all appears to correspond is *M. hyperythra*.

Muscicapula tickelliae : Tickell's Blue Flycatcher.

Well distributed through Coorg at medium elevations. It does not, I think, ascend the hills above 4,000′. It is perhaps commonest in the Inter-Zone, both in the evergreen *sholas* and in coffee, and extends all through the Deciduous Forest and into the Dry Zone wherever there are clumps of large trees, such as mango topes and roadside banyan avenues. It is an arboreal species finding most of its food in the air or among the treetops, and seldom if ever comes to the ground. The breeding season is late—chiefly May and June. The males sing at intervals throughout most of the year, but in April and May their tinkling cadence is to be heard continuously. Most of the nests which I have seen were built in crevices formed by the twisting aerial roots of large parasitic fig trees. They are at any height from the ground, usually well up, and consist of a little loosely-packed pile of green moss filling up the hollow, with a shallow cup lined with black roots. I have one record of a nest in an old barbet hole.

Eumyias albicaudata : The Nilgiri Verditer Flycatcher.

I have never seen this species in Coorg. Since however Sálim Ali has obtained it both in the Billigiris and the Bababudans, it seems probable that it must exist in the province on the Coorg Ghats, though it is certainly very rare, as so distinctive a species would not be easily overlooked, and I have searched for it carefully.

On the Nilgiris where it abounds, breeding takes place in March/April. I have found many nests, in cracks in trees or among the hanging roots on an undercut bank at no great height from the ground. They are substantial cups of moss, lined if at all with black rhizomes. The *sholas* and well-wooded gardens and plantations are its favourite haunts at an elevation of 4,000′ and upwards. The song is a sweet little warble up and down the scale.

Eumyias thalassina: The Verditer Flycatcher.

A regular winter migrant and widely spread but in small numbers. I have seen them most often in coffee cultivation, where they occur singly or in pairs, keeping to the highest treetops and hawking flies in the usual flycatcher manner. They are late in arriving and leave early. I have not seen them before the last week of October, and often not until November, and they have left by early February. While in Coorg I have never heard them attempt to sing or even utter a call note.

Alseonax latirostris : The Brown Flycatcher.

Alseonax muttui : Layard's Flycatcher.

I am not certain of the respective distribution and status of these two species. *A. latirostris* undoubtedly occur throughout the year as a resident in small numbers as I have records of seeing it in every month, and I saw one feeding a newly flown juvenile on May 16th. Numbers, however, are greatly increased during the winter months, and it looks as if the small resident population is augmented by migration from the north. Some of these are probably *A. muttui* which I am not prepared to identify in the field. Coffee cultivation and light deciduous woodland, or the borders of evergreen *sholas* at medium elevations are their favourite haunts. They are nearly always seen singly, and are silent unobtrusive little birds, keeping to the treetops and catching flies on the wing.

Ochromela nigrorufa: The Black-and-Orange Flycatcher.

This is another montane species common in the Nilgiris whose furthest northern limit appears to be the Billigirirangan Hills. I have searched for it most carefully in the Coorg Ghats which appear to provide a perfectly suitable biotope but without success. In the Nilgiris it occurs freely from 4,500′ upwards. These birds are far from being typical flycatchers in habits. They frequent dark, evergreen *sholas* with a plentiful undergrowth of *Strobilanthes* or bamboo. Here they hop about among the undergrowth, seldom ascending far from the ground. They are silent birds and appear to have no song. The alarm note is the usual flycatcher '*zit, zit*', and they have another call note, a melancholy, low '*pee*'. They are tame and confiding, especially so at the nest. This is normally built low down in a shrub in the interior of a *shola* though I have found them just outside. It is almost indistinguishable from that of *Rhopocichla atriceps*, a ball of dead leaves, sometimes lined with grass, and sometimes quite unlined. The normal clutch is two. In the case of one pair which I watched building, the hen did all the collection of material and construction, but the male was in close attendance. A juvenile being fed by its parents had black wings, and russet rump and tail as in the adult, while the head, back, and underparts were speckled light and dark brown. May to July seems to be the normal nesting season.

Culicicapa ceylonensis : The Grey-headed Flycatcher.

The status of this bird in Coorg is rather obscure. It is presumably resident in the hill *sholas* but I have not been able to confirm breeding. They are certainly most numerous in the higher and wetter parts of the province, but are nowhere as common as in the Nilgiris. Elsewhere they are to be found at times throughout the Inter-Zone in evergreen jungle and coffee cultivation but I have not seen them in deciduous forests. At the lower elevations, they are wanderers, here today and gone to-morrow, though a pair may occupy a particular beat for some weeks together. They turn up at any time of year except between March and May, when they are presumably breeding in the hill forests. I have found nests in the Nilgiris and the Ceylon hills in May. They have been variously built on mossy tree trunks, a moss-grown boulder, or a bare earth cutting. The nest is a beautiful little half-cup of moss or lichen, felted with cobwebs and is usually composed of the materials of the background to which it is attached so that it is far from conspicuous. The sides of the cup are continued up for several inches to strengthen the support on the vertical face. All clutches I have seen have been three.

These little flycatchers are among the most active of their tribe, performing the most vigorous acrobatics in pursuit of their prey, and are constant members of the mixed flocks, acting, as Sálim Ali well puts it, as outriders, nipping up any particularly agile insects which escape the main body. They have a short, sweet, and surprisingly loud song, which is constantly uttered.

Tchitrea paradisi : The Paradise Flycatcher.

Apparently purely a winter migrant in this area. They begin to appear in early October, and I have records up till the end of April, but I have not seen them during the monsoon, nor have I been able to detect any suggestion of their breeding in the province. Throughout the winter months, they are to be found in small numbers, usually singletons, all over the country; in orchards and gardens in the Dry Zone, throughout the deciduous forest and coffee lands of the Inter-Zone, and well up the slopes of the Ghats. They prefer fairly dense, shady woodland, particularly along river banks and near water. All phases of plumage may be seen, though fully white males are not as common as females and juveniles, while males in the long-tailed red plumage are rare. It commonly associates with the mixed flocks until these break up at the onset of the breeding season.

Hypothymis azurea : The Black-naped Blue Flycatcher.

Quite common in the Inter-Zone. I have not seen it in the Dry Zone nor on the Ghats above 4,000′. They like shady, well-wooded country, particularly coffee cultivation. They are spritely, active birds, regular members of the mixed flocks. There is no song, but the constantly uttered, grating, double call-note is quite distinctive. They are always on the move, and when excited they have a habit of posturing and fanning the tail somewhat after the manner of *Rhipidura aureola* but not nearly to such an exaggerated degree.

Breeding starts rather late. I have found a nest in early March but one most commonly comes on them in late April and May. They are not hard to find if the birds are watched as the latter are by no means secretive. They are dainty, conical cups about 3½″ in depth by 2½″ in diameter, firmly bound to a vertical twig usually at the end of a pendant spray. I have found them on coffee bushes within two feet of the ground, but twelve to fifteen feet is more usual; often fully exposed on a bare bamboo. They are made of shreds of bark and cobweb, the exterior plastered with cobweb and cocoons until it is quite white. The hen does all the building, though the cock accompanies her closely. She sits in the incomplete nest, turning round and round, shaping the cup with her body while plastering the outside or weaving in the strong grass rim with her bill. The lining is of fine grass and the usual clutch three.

Rhipidura aureola : The White-browed Fantail Flycatcher.

Confined strictly to the Dry Zone and uncommon there. It is found in fairly open country in the neighbourhood of mango topes and banyan groves. It is apparently resident, but I have not found a nest. It is frequently seen singly, though sometimes keeping company with a flock of some other species such as *Turdoides*, *Dumetia*, *Chrysomma* or *Franklinia.*

It is an odd little bird, constantly pirouetting with extended wings, and the long tail spread in a wide fan. The song is a merry, little whistle of several notes, frequently uttered.

Lanius vittatus : The Bay-backed Shrike.

Restricted to the Dry Zone where it is found in small numbers in open, scrub-grown wasteland. It is undoubtedly resident, though I have not found the nest. A typical shrike in every way. From its behaviour, I suspect it is a late breeder, nesting in May and June after the early showers have brought on a growth of vegetation and insect life.

Lanius schach : The Grey-backed Shrike.

Well distributed throughout the more open parts of Coorg, but not, I think at high elevations, though in the Nilgiris it is common enough on the Plateau at 6,000′. In Coorg I have not seen it above 4,000′. In the Inter-Zone it will be found wherever open grazing land occurs, and in the Dry Zone in smaller numbers in the same country as the last species though, as Sálim Ali remarks, it tends to prefer a rather more wooded and orchard-like facies. Numbers are never large as it is highly territorial and each pair maintains a large hunting ground which is strictly preserved and occupied throughout the year.

In the Eastern Ghats Survey, Whistler suggests that some of the Coorg birds may be winter migrants, *L. s. erythronotus*, but in fact all our birds seem to be strictly resident, and I have seen no signs of a winter influx of visitors.

They are bold, fierce birds whose usual note is a harsh scream. In the breeding season however, the male has a sweet song. It is uttered in a low, meditative tone, and the bird is an excellent mimic introducing all sorts of other avian songs and calls.

The nest is usually placed in some isolated thorn bush well out in the open. Although in most cases in the heart of the bush, and well-protected by thorns, it is seldom at any considerable height from the ground, nor particularly well-concealed. As I have noticed however in the case of the European Red-backed Shrike, the materials used in the exterior of the stoutly-woven cup are of an untidy, ragged, weatherworn nature—small sticks, fragments of 'Old Man's Beard,' and dead leaves and grass—so that at a casual glance the nest looks like an old one. The lining consists of roots and grass. Four eggs form the normal clutch, sometimes five. Breeding does not begin much before mid-April, and most nests are found in May.

Lanius cristatus : The Brown Shrike.

One of the commonest winter migrants to Coorg. It occurs, always singly, all over the province in all types of country except the interior of evergreen forest. It is one of the earliest arrivals, and among the last to depart. The first come in during the second or third week of September, and most have left by the end of April, but I have seen stragglers in early May. A large proportion of the birds visiting us are juveniles with the lower plumage still faintly barred.

Hemipus picatus : The Black-backed Pied Shrike.

This little bird, in its habits, is much closer to the wood-shrikes and minivets than to the true shrikes. It is fairly common at medium elevations throughout most of the province. I have not noticed it above 4,000′, and on the Ghats it avoids heavy evergreen forest. It is most numerous in the lighter woodlands of the Inter-Zone coffee lands, and the adjoining deciduous forest, becoming scarce if not entirely absent in the Dry Zone. It is strictly arboreal, and haunts the treetops in small family parties, hawking insects actively on the wing like a flycatcher. It utters constantly a wheezy call-note of three or four syllables.

Breeding takes place mostly in March while the deciduous trees are still bare. The nest is built on a horizontal bough of a dead, or at any rate leafless, tree, usually at a great height from the ground. It is a tiny, very neatly-built, cup scarcely two inches in diameter, constructed of lichen and cobweb, and so woven and blended to the upper surface of the branch that from below it appears as a scarcely discernible knot in the wood. Small as is the bird, when sitting she overlaps the nest to such an extent that except for her rather hunched-up attitude, it is hard to realise that she is not perching normally. The camouflage extends to the young as they are covered in grey down of the same colour as the nest and bough, and except in the presence of their parents remain in a state of rigid stillness with beaks pointing vertically, and are practically invisible. The arrival of the old birds with food breaks the trance however, and I once saw a family roused to a great state of excitement and demonstrativeness by a sunbird which settled within a foot of them. The only nest which I have been able to reach was unusually low, 15′ up. The lining was of dried, fine grass. Both birds were taking part in the building, but it was deserted on completion before eggs were laid.

Tephrodornis gularis: The Malabar Wood-shrike.

A very common species in the wetter parts of the province at medium elevations. It is found everywhere in evergreen forest up to 4,000′ but preferably of a light type, in well-wooded park land, and especially in coffee cultivation. It occurs in lessening numbers through the deciduous forest belt, but its place is taken in the Dry Zone by the next species.

Through much of the year, particularly after the breeding season, they are found in large flocks, which make up a major proportion of the mixed hunting parties. At this time of the year they are very noisy, constantly uttering a loud call – '*chrrr, whit-tu, whit–tu, whit–tu*' or a harsh, querulous, single – '*chak*'. The flight is undulating with slow, sailing wingbeats. They are active enough at catching insects on the wing, but their special hunting grounds are the trunks and branches of tall trees. Their eyesight must be very sharp as they will sail down and pick an insect off a treetrunk fifty yards from their perch. They specialise in those of the largest size, big moths, locusts, and caterpillars which are hammered into subjection on a bough. In the evenings the flocks may be seen bathing in a pool or stream, swooping down and dipping on the wing as flycatchers and drongos do.

During the breeding season, they become shy and secretive, and the nests are extremely hard to find. The birds are paired by January but the main nesting period seems to be in mid-May. The few nests I have succeeded in finding have been in substantial horizontal forks of shade trees in coffee at twenty or thirty feet from the ground. They are shallow saucers about 4 inches in diameter, cemented with cobweb onto the upper surface of the bough where it widens into the fork, and practically nothing shows from below. The sides are built up for an inch and a half with felted lichen and cobwebs, and the lining is of grass and leaf-stems. Two eggs appears to be the normal clutch. The juveniles when they leave the nest are speckled grey all over the upper parts, particularly on the head, but very soon assume the adult plumage.

Tephrodornis pondicerianus: The Common Wood-shrike.

This species replaces the last in the Dry Zone. The two overlap on the borders of the deciduous forest, but the present species is much less a woodland bird than its larger relative and is quite at home in scrub jungle, provided there are a certain number of small trees. Their habits are very similar to the last, but they are not such noisy birds, and occur in smaller flocks, family parties of five or six being the rule. Breeding takes place in February and March, for they do not wait as do so many of the Dry Zone birds for the first showers. The nest is built, entirely exposed, on a horizontal branch of some leafless tree. They are small replicas of those of *T. gularis* and quite as hard to see unless given away by the owners. Three eggs seem the normal clutch. The young are clad in grey down, exactly the colour of the nest and the lichen-covered bough on which it is built. Both parents feed the young on insects, many of which are caught on the ground.

Pericrocotus flammeus: The Orange Minivet.

A common bird all over the Wet Zone in forested country, found in the hill *sholas* up to the tree limit, also through the wetter portion of the Inter-Zone, particularly in coffee land. They hardly enter the deciduous and are not found at all in the Dry Zone. They are very conspicuous birds, with their bright colouring, and spritely flycatcher-like ways. They roam through the tree-tops in small parties of half a dozen or so, in which scarlet males are in a minority. Common as they are, I have not been able to find a nest in Coorg, nor discover much about their breeding habits. They appear to flock practically throughout the year, and evidently nest high up among the tree-tops. I have seen nests blown down in a storm which were presumably attributable to this species, and in the Nilgiris saw one building in a tall Blue-gum in November. On the other hand a male shot in September was in post-nuptial moult, and I have records of males in transformation plumage from yellow to red in February and July so it looks as if the breeding season is a prolonged one.

Pericrocotus peregrinus: The Little Minivet.

The Little Minivet is common in the Dry Zone, and the adjoining deciduous forest belt, and is fairly common in the drier portion of the Inter-Zone in coffee land, but appears to be merely a wanderer there, appearing spasmodically. It is absent from the higher and wetter parts of the province. In the coffee shade trees, their habits resemble those of the last species. They range the tree-tops in company with other birds. On the other hand they are quite at home in the Dry Zone scrub, where the largest trees are little more than bushes. The breeding season appears to be mainly in March and April at which time the birds are seen in pairs which keep very close company. The only nest I have seen was just begun when found on April 22nd. Both birds were bringing lichen to a bough seven feet from the ground in a thorn bush in open scrub. The nest was apparently complete a week later, but never contained eggs. It was a beautifully neat, very deep little cup of flakes of lichen and bark bound with cobwebs to the upper surface of the branch, and lined with rootlets. The walls though firm and strongly woven were extremely thin. Although not quite so well camouflaged as the nests of *Hemipus* and *Tephrodornis*, it was by no means noticeable even at a range of a few feet, though quite unconcealed by foliage.

Lalage sykesi: The Black-headed Cuckoo-shrike.

A fairly common resident in the Dry Zone, both in cultivated areas and scrub jungle. Over the rest of Coorg, it seems a regular winter visitor, arriving about the second week of October, and leaving in March, and spreading all over the province up to considerable elevations on the Ghats. Even in its winter haunts, however, it is a bird of fairly open country with scattered trees, avoiding continuous forest and even heavily wooded cultivation such as coffee under shade. It is usually seen singly, and is a quiet bird. I cannot recollect hearing even a call-note. It works the upper branches of trees and tall bushes for insects, flying out to catch prey escaping on the wing. The only nest I have found was in the Dry Zone in a small, isolated tree twenty feet high in open scrub-grown grazing land on June 7th. The foliage was thin and the nest, though small, was in a bare fork of two twigs about a foot from the top and was not inconspicuous. It was a shallow saucer about 2½′ in diameter and was made of dry grasses, lightly bound with cobweb, forming a compact and firm structure, but lacking the finish of the nests of the minivets and wood-shrikes. It contained one well-grown chick and an addled egg.

Coracina novaehollandiae [macei] ; The Large Grey Cuckoo-shrike.

A wandering species found in small numbers all through the deciduous forest belt, the adjoining parts of the Inter-Zone, and the better wooded portions of the Dry Zone. They are usually seen in pairs or small parties, and seldom remain in one locality for more than a day or two. They keep to tall trees, playing follow-my-leader from one to another with a swooping, undulatory flight, and are extremely noisy, constantly uttering loud, querulous screams. The only nest I have seen was found at the end of January. It was sixty feet up in a huge *Bombax* tree on a fireline in the deciduous forest. It was built in a horizontal fork of an outlying branch, and was quite inaccessible. It appeared to be a small cobweb-covered hammock rather after the drongo pattern.

Artamus fuscus: The Ashy Swallow-shrike.

A very local species, but common where it occurs. Confined to the deciduous biotope of the Inter and Dry Zones. It is most commonly seen in teak and sandal clearings in deciduous forest reserves, where isolated dead trees provide suitable perches and nesting sites. In habits it closely resembles the bee-eaters. Numbers may be seen perched, huddled together, flying out to capture their insect prey which is invariably taken on the wing, and like bee-eaters they often soar for considerable periods at great heights from the ground. They are particularly active at sunset, especially when a flight of termites is emerging. They are bold birds, and chase with harsh cries any hawk or other raptor which appears in the vicinity. The only nest I have knowledge of, was being built on April 15th, in a hollow on the upper surface of a main bough of a dead tree, 40′ up and quite inaccessible, in a sandal clearing. Both birds were very busy bringing bits of grass, but one, presumably the female, appeared to be doing all the actual construction, her mate passing over the materials as he brought them. They were very noisy at this time, uttering loud, querulous cries.

Dicrurus macrocercus: The Black Drongo.

Very numerous throughout the province during the cold weather except in dense forest and on the higher hill tops. They arrive in October and leave by the middle of March. Where our birds breed I do not know as they are not found in the Dry Zone in the nesting season, nor in the adjacent parts of the Mysore Maidan.

They are about the last of the diurnal birds to go to roost, and a familiar spectacle on a cold weather evening is to see numbers, each perched on the topmost twig of some commanding tree, flying up vertically at frequent intervals to snatch some crepuscular insect outlined against the afterglow, and diving back with closed wings to their perch. Like all drongos, this bird bathes on the wing, plunging down to the surface of a pool or stream, dipping, and returning to a perch to shake off the drops and preen.

Dicrurus longicaudatus: The Grey Drongo.

Similar in habits and status to the last species, arriving and leaving about the same time. The two species being so alike, I have found it difficult to discover any outstanding difference in their distribution or mode of life. Their range is more or less coincident, but the Grey Drongo appears to be a bird of more forested country than its congener. Both birds are regular attendants at the nectar feasts provided by flowering trees.

Dicrurus coerulescens: The White-bellied Drongo.

A resident species confined to the eastern borders of the deciduous forest belt and the adjoining better-wooded portions of the Dry Zone. Forest clearings and scrub jungle with a fair growth of large trees are its favourite haunts. Sálim Ali particularises bamboo facies, but while this is popular, it is in my experience nowise essential. It is widely distributed but is never numerous, each pair maintaining a wide territory. It is a typical drongo in all respects, bold, conspicuous, and aggressive, resembling the last two species in calls and habit.

Nesting begins in the latter half of April at which time unless there have been unusually early rains, the trees are completely leafless and the whole country bare and burnt over. The nests I have seen have been built in horizontal forks of isolated trees at heights of 15 to 25 feet. They are usually well out towards the tip of a bough, but the fork chosen is a substantial one, and the nest, which is a shallow, firmly-woven saucer of grass and bark shreds, is wedged into it, but is not bound on with cobweb, of which little is used. The normal clutch is of three eggs. Both birds feed the young. Being fully exposed to the hot weather sun, one of the pair spends most of the time brooding the chicks while they are still naked, while the other does the foraging.

Chaptia aenea: The Bronzed Drongo.

One of the most familiar resident birds of the Inter-Zone. It avoids extensive stretches of evergreen forest and is not found in the higher or wetter parts of the province, and it is also absent from the Dry Zone, though common in the deciduous forest especially in teak and sandal clearings. But undoubtedly its favourite haunts are the light woodlands shading coffee and cardamom plantations. It is a typical little drongo, noisy and demonstrative, with a great variety of calls, many strongly imitative. One common alarm note is very like the scream of the shikra. Pairs keep together throughout the year, each maintaining a permanent territory and breeding in the same vicinity season after season. They are strictly arboreal, and never leave the shelter of the woods, and will not be seen perching on the ground in the open or on a cow's back as the Black Drongo does. Breeding starts in March and continues till May, but I think only one brood is reared though the birds will build a second time if the first nest is destroyed. They are very loath to desert. I knew of one bird which continued to sit after one of the eggs had been broken in the nest. Another, after being robbed, laid again in the same nest shortly afterwards.

The nests are mostly built at a moderate height only, from 12 to 25 feet. The usual site is a horizontal fork in the terminal twigs of a lateral branch of a sapling or small tree growing among others of larger size. Tari (*Terminalia belerica*) is a very favourite species. It is leafless during the breeding season and the nests are in no way concealed. Nevertheless, and though the birds are far from shy, they are not at all conspicuous, being small, shallow hammocks of fragments of inner bark, felted and cemented on the outside with cobwebs until they are nearly white in colour. The lining is of grass. Both birds take part in building. While applying the cobweb, the bird sits in the nest, turning round and round, apparently smoothing the exterior with its chin. Unlike the last species, the nest is actually slung under the fork not built on top of it. Three eggs are the usual clutch. The young are driven out of the breeding area by June, the old birds remaining throughout the monsoon silent and subdued, being then in full moult. Specimens with half-grown outer tail feathers are commonly seen in July.

Chibia hottentota: The Hair-crested Drongo.

A rather mysterious bird whose status I have been unable to determine. They are decidedly uncommon, but I have records of them from Pollibetta in S. Coorg, and Somwarpet in N. Coorg, both in the Inter-Zone. One or two are seen every year for a few days between November and March and then disappear. They seem to be entirely dependent on the nectar feasts provided by flowering *Bombax*, *Erythrina* or *Acrocarpus*, and only on one occasion have I seen one anywhere except among the hosts of drongos, bulbuls, mynahs, grackles and other birds which visit these trees in the flowering season. They are silent birds and extremely shy but their size and peculiar square-cut tails, curled up at the outer edges like a Blackcock's are very distinctive. The trees they frequent are of the largest size, and as these giants are nowhere very numerous, it seems as if the birds must wander widely in search of their favourite food. Where they breed or how they subsist when the blossoming season is over is an unsolved problem.

Strangely enough I have found this species to have entirely different habits at the other end of India, in Assam. There it occupies much the ecological niche which *Dissemurus paradiseus* holds in Coorg, being common in shaded tea gardens and light deciduous forest, and bold, tame and familiar, whereas *D. paradiseus* in Assam is a shy bird of the deep forest.

Dissemurus paradiseus: The Racket-tailed Drongo.

The range of this species coincides almost exactly with that of *Chaptia aenea*. It is a forest drongo, and is never seen outside continuous woodland, but on the other hand avoids the depths of dense jungle. It occurs on the outskirts and in clearings in the Wet Zone evergreen from the lowest elevations up to 4,000′, avoids the higher hills, but turns up again in great numbers in the Inter-Zone in the coffee and cardamom plantations. It extends into the border of the deciduous forest belt but gets scarcer as the country becomes drier and is absent from the Dry Zone.

The Racket-tailed Drongo and the Tree-pie are the chieftains of the coffee avifauna. Bold, bullying, and aggressive, they are masters and leaders of the mixed flocks, both in foraging and in mobbing attacks on any owls or hawks which venture into their domain. Their food consists of insects of all sorts up to the largest size, and I would not put it beyond them to attack nestlings, or small, weak birds. On two occasions I have seen one pounce on a particularly large sphingid larva and carry it off in its claws, a raptorial action I have seen used by no other passerine bird.

I have previously remarked on the apparent association between this bird and *Dendrocitta vagabunda*. It certainly seems to be something more than a simple case of common habitat and similar tastes in food. I have several times found the nests of the two very close together, once in adjoining trees, and have seen a pair of Racket-tailed Drongos feeding four newly-fledged young who were perched within a few feet of four young Tree-pies of similar age, also busily attended by their parents without the slightest friction between the two families. Both species are territorial and only one pair of drongos and one of tree-pies will be found in any one particular area.

Nesting begins in early April and only one brood seems to be raised. Their nesting habits differ considerably from those of the smaller drongos. The tree chosen is one in full leaf, favourite species being Atti (*Ficus glomerata*) and Beeti (*Dalbergia latifolia*). It is usually a tall sapling growing among larger trees, and the nest is either in the topmost twigs or towards the end of a lateral branch, seldom less than twenty feet from the ground. It is a hammock of bark and grass firmly slung to the twigs of a horizontal fork, but unlined and so loosely woven that the eggs can be seen through the bottom. No cobweb is used in the construction. The sitting bird is shy and silent, slipping unobtrusively off the nest at the first sign of alarm, but her mate who remains on guard at a safe distance is as noisy as usual. They are very faithful to their chosen breeding sites. I have records of nests for four consecutive years in a particular tree. Three eggs is the normal clutch, but as mentioned above I have seen four young being fed. The young on leaving the nest have short tails but the rackets are fully grown by mid-June. The old birds go into moult in July and August and lose their rackets at this time. The new ones grow from the quill in their final form—an inch or more of normal feather, and then six inches of bare shaft with the webbing reduced to a mere vestige. There seems to be no sign that the birds trim off the webs themselves as the S. American motmots are said to do.

The Racket-tailed Drongo is the noisiest of a noisy family. Their range of calls both harsh and pleasing is extraordinary, and they are remarkable mimics. In fact in their haunts any unusual and unfamiliar bird note of any considerable volume that may be heard is likely to be found to emanate from one of them.

Acrocephalus stentoreus: The Indian Great Reed-Warbler.

According to the Eastern Ghats Survey, there are two specimens from Coorg in the B. M. I can only claim sight records which are not reliable in the case of the warblers, but as far as I have been able to determine, this bird is a regular winter migrant to Coorg in rather small numbers turning up almost anywhere but chiefly in open country with plenty of scrub and long grass often at a considerable distance from water.

Acrocephalus dumetorum: Blyth's Reed-Warbler.

A very common winter visitor throughout most of the district. It avoids heavy forest and is most numerous in the more open parts of the Inter-Zone, where scattered lantana brakes provide convenient cover. It is an arrant skulker, very hard to flush but makes its presence known by its constantly uttered call, a sharp, single '*tchk*'.

Acrocephalus agricola: The Paddy-field Warbler.

Two specimens were collected by W. Davison in the Brahmagiris, but I have not come on it myself.

Orthotomus sutorius: The Tailor Bird.

I have only noted this species in the Inter-Zone and the lower slopes of the Ghats where it is common. It avoids heavy forest, and is definitely scarce in the Dry Zone scrub if it occurs at all. Cultivation, gardens, and open jungle are its normal habitats. It is everywhere resident, breeding mostly during the monsoon when the herbaceous growth it requires for nesting is at its maximum. At this time the birds are very vocal, and their loud–'*chu–bit, chu–bit, chu–bit*' resounds all day long, a call of astonishing volume for so small a creature. Normally quiet and skulking mouse-like among the the undergrowth, under the stress of sexual excitement the cock climbs to an outstanding twig and pours out his feelings, his whole body vibrating with the effort, his tail cocked till it nearly touches his back, and the feathers of his throat parting to show their dark bases which gives him the appearance of having a black gorget.

The nest may be built into one large or several smaller leaves. The site chosen is in some soft-leaved herb and is seldom more than three feet from the ground. The leaf or leaves are sewn into a bag with thread made of vegetable down. One continuous thread may serve for several stitches. The ends do not appear to be knotted but flock out naturally and hold themselves in place. The upper portion of the leaf nearest the stem arches over and protects the aperture which faces into the interior of the shrub. The true nest is built inside the leaf container, and consists of a soft cup of green moss, feathers, spiders' egg bags, bast, and vegetable floss. The rim is strongly reinforced with bark fibre. When built near houses or in pot plants on a verandah, as is often the case, all sorts of unusual materials such as bits of string, wool, or cotton may be used. Three eggs are the usual clutch. The hen when disturbed slips off quietly until she is at a safe distance when she demonstrates loudly. After the young have flown the families often join up with the mixed flocks.

Cisticola exilis : The Red-headed Fantail Warbler.

This bird has been recorded from the Brahmagiris in S. Coorg. A small, dark warbler, which I believe is this species, occurs somewhat scarely all along the line of the Ghats. I have only seen it at high elevations of 5,000′ or over, where it lives right in the open among the foot-high dwarf *Strobilanthes* which covers the hilltops above the tree-line in a continuous carpet in many places. The little bird bobs up under one's feet like a tiny quail, slips a dozen yards with a weak, fluttering flight, and disappears into the *Strobilanthes* again, and is almost impossible to flush a second time.

Cisticola juncidis: The Streaked Fantail Warbler.

There are specimens from Coorg in the British Museum. In my original Notes on the Birds of Coorg (*JBNHS* May 31, '29) I recorded this species as very common. In the light of maturer experience, and the knowledge of the danger of claiming definite records of the warblers from mere sight observations, I must retract this, and cannot affirm that I have ever unmistakably identified this bird in Coorg.

Franklinia gracilis : Franklin's Wren-warbler.

A regular and fairly numerous resident in the Dry Zone scrub, where in the off season small parties roam through the lantana brakes often in company with *Dumetia albogularis.* I have only seen them in the Inter-Zone and the deciduous forest in July and August during the height of the monsoon. At this time of year, the breeding season, they are particularly noisy and conspicuous and I may have overlooked them at other periods. I have not found the nest in Coorg, but came across several in the Ochterloney Valley of the Nilgiri-Wynaad, where they are very common in the long elephant grass, covering wide stretches of land once cleared for coffee, but long abandoned. They were of two types, but were all built in large-leaved herbaceous plants growing in the open among long grass. One form was a cup of fine grass flower-heads, lined with still finer grass stems, slung all round the rim by threads of cobwebs to the under-side of a leaf which formed a lid, leaving a small entrance where the leaf-stalk joined the stem of the plant. The others were just like tailor-birds nests. The two sides and the end of a large leaf were sewn into a bag, and the nest proper built inside. The clutches I found were in each case threes.

Phylloscopus spp.

Several species of Leaf Warblers are very numerous as winter visitors in Coorg, but not having shot specimens, I am not prepared to attempt to identify them.

Prinia sylvatica: The Jungle Wren-warbler.

A Wren-warbler, almost certainly this species, occurs in the Dry Zone where its habitat seems to be restricted to the stony, uncultivated ridges sparsely grown with grass and scrub which are a feature of the area. A nest I found on August 19th was built in a tiny isolated thorn bush, a foot high. In the middle of this was a little domed purse, roughly egg-shaped, loosely made of coarse, broad-leaved grass lined with finer grass. The two fresh eggs were whitish in ground colour, well-marked all over with spots and blotches of reddish brown and grey.

Prinia socialis: The Ashy Wren-warbler.

Considering what a familiar and common little bird this is in the Nilgiris, it is rather remarkable that in Coorg it appears to be extremely rare. Being one of the few warblers easily recognisable in the field, I do not think I am likely to have overlooked it. My only record is from a vegetable garden on the outskirts of Hebbale, a village in the Dry Zone.

Prinia inornata: The Nilgiri Wren-warbler.

A small wren-warbler which I suspect is this species is common all through the Inter-Zone and the lower slopes of the Ghats wherever paddy cultivation occurs. It frequents growing paddy, and the long grass of the bunds, and is probably a late monsoon breeder when the crop has reached its full height, as it is most conspicuous and noisy at that time. I have not found the nest however.

Irena puella: The Fairy Bluebird.

The true home of this species is the evergreen rain forest of the Ghats from the lowest elevations up to about 3,500′ or a little higher. Here it is common, and may be considered one of the most typical inhabitants of this biotope. It occurs, however, as well all through the Inter-Zone wherever patches of evergreen jungle are found, and is a regular member of the avifauna of coffee plantations. It is more or less resident, but like most frugivorous species wanders a good deal according to the food supply. The various wild figs make up a large part of its diet, and it is very partial to the nectar of flowering trees. Pairs are usually seen and they are noisy birds. The male has an explosive, liquid, bubbling whistle of two notes—'*whit–tu, whit–tu, whit–tu.*' As it calls the tail is jerked sharply as if with the effort of forcing the air out of the lungs.

I have found nests from March till May. In the jungle they may be in any dense-foliaged evergreen, and they are hard to find, but in coffee plantations in nine cases out of ten they are in 'jak' (*Artocarpus integrifolia*) saplings, so much so that if a pair is suspected of breeding in an area, it is usually sufficient to search all the small jak trees in the neighbourhood to find the nest at once. It seems a *sine qua non* that the chosen tree should be a dense and shady one. The nests are built in a fork well in the interior from 15 to 20 feet up, though I once found one in a coffee bush at 5 feet. This however was quite exceptional. The hen does all the building, the cock accompanying her, calling loudly, and thus often giving the game away. The nest is very distinctive and cannot be mistaken for that of any other bird. It consists of a rough platform of straight dead twigs six or seven inches long and remarkably thick, often at least ¼″ in diameter. On this is spread a layer of green moss, and a scanty lining of rootlets and leaf-ribs, with sometimes a few *Albizzia* leaves plucked green. Two is the invariable clutch in my experience. Both birds feed the young which are clothed from the time of hatching in a thick coat of gray down.

Oriolus oriolus: The Indian Oriole.

A common winter migrant throughout the province up to about 4,000′, most numerous in the Inter-Zone, and scarce if at all present in the drier parts of the district. Females and young males come in about the end of October, but the mature males seem much later in arriving, and will seldom be seen before December. Even then they are considerably in the minority. They are always to be seen among the mixed flocks in the coffee plantations though their food is largely vegetable; the various wild figs and other fruit and berries. They are noisy birds, their principal notes being a harsh shriek like that of *Coracina novaehollandiae* and the mellow flute-like whistle which gives them their English name.

Oriolus chinensis : The Black-naped Oriole.

I have only once seen this bird, a solitary male in rather dull plumage in a coffee estate at Pollibetta, S. Coorg, on Feb. 7th. I was able to make a close and careful observation, and have little doubt of the correctness of the identification.

Oriolus xanthornus: The Black-headed Oriole.

A rather uncommon resident confined to the Dry Zone where it is found in the wilder and better wooded parts, and in the adjoining portions of the deciduous forest. They wander a good deal in the off-season, being frugivorous, and fruit-bearing trees scarce and widely scattered in their habitat. They are nearly always seen in pairs, and betray their presence by their frequently reiterated, melodious whistle, a note not unlike that of *O. oriolus* but with a distinctive 'timbre'.

The only two nests I have found were begun in the early part of April and completed by the middle of that month. They were both in small isolated trees, standing in 'maidans' in light, open forest. They were deep hammocks of strips of tow-like inner bark, the rim firmly bound to the underside of a horizontal fork of an outlying bough at a height of about ten feet. The lining was of grass, and in the only one in which eggs were laid, a clutch of two was incubated. The female did all the construction, the male accompanying her, calling constantly. They were far from shy, and were extremely noisy in the vicinity of the nest.

Gracula religiosa: The Southern Grackle.

A common species in the wetter parts of the province, occurring in evergreen forest from sea-level upwards, but most numerous in well-shaded coffee and cardamom plantations between 3/4,000′. They avoid open country and even deciduous forest unless there is a fair admixture of tall evergreens, and they are completely absent from the Dry Zone. They are frugivorous, living mainly on the various wild figs. When the 'Goni', (*Ficus mysorensis*) is in fruit, the widespreading branches festooned with orange-coloured figs attract swarms of birds among which this species with the barbets and green pigeons are the most numerous. They also visit flowering *Grevillea*, *Acrocarpus*, *Bombax* and *Erythrina* trees in great numbers. They seem more sedentary birds than most fruit-eaters and a good deal of insect food must be consumed, though they rarely if ever come to the ground. Small flocks are seen throughout the year and they are extremely noisy with a wide range of wheezes, chuckles, and whistles, some melodious, some the reverse. They are favourite cage-birds and can be taught to talk or whistle a tune as well as any parrot. The flight is direct and powerful, the wings making a distinct whirring sound.

The breeding season is in March and April. If suitable trees are available they breed colonially. They prefer above all others tall, soft-wooded species of the largest size, particularly *Albizzia* and *Erythrina indica*, springing up 40/50′ without a branch. In the main trunks of these they make their own excavations, large oval holes up to 6″ in vertical diameter at any height above 30′. Their work can always be recognised by the untidy, chewed appearance of the bark round the edge. Internally the cavity is capacious, about a foot deep by eight inches wide. There may or may not be a rough lining of rubbish. Several pairs use the same tree, and revert to it year after year, the trunk becoming peppered with borings. In the event of their favourite sites being unobtainable they will use dead trees that have gone soft and rotten or enlarge woodpecker holes in those which would otherwise have been too hard for them to work on.

Pastor roseus: The Rosy Pastor.

A regular winter visitor to Coorg, but very variable in numbers. In fact they may really be only birds of passage as they never remain for more than a day or two in any one locality. They are usually only seen between January and March, frequenting open cultivated country in small parties in company with flocks of other species of mynahs. The *Bombax* and *Erythrina* trees are in bloom at the time of their visits, and are the most likely places to find them, though I have seen them feeding on wild figs.

Sturnia malabarica: The White-headed Mynah.

One sub-species at any rate, probably the typical one, is a common resident, and it is almost certain that *S. m. blythii* occurs as well as a winter visitor, but not having shot specimens I cannot vouch for this. The White-headed Mynahs are mostly to be found in the Inter-Zone between 3,000′ and 4,000′. They are absent from the Dry Zone and avoid high altitudes and continuous forest. Fairly open but well-wooded cultivation, and coffee and cardamom plantations are their favourite habitat, particularly village grazing grounds which provide spaces of open sward and numerous large trees which are continually lopped for firewood and whose limbs are in consequence gnarled, twisted and full of holes—admirable nesting sites for mynahs and paroquets. They are arboreal birds and seldom come to the ground. While largely frugivorous they consume a good deal of insect food, which they obtain by searching the crannies of the bark of the upper limbs of tall trees. After the breeding season, they unite in family parties but mostly disappear during the worst rains returning in large numbers in September. The cold weather flocks are often large, and they patronise big communal roosts in company with *Aethiopsar fuscus* in reedbeds in tanks or isolated thickets of lantana. It is a most interesting sight on a December evening to see the flocks of various sizes coming in from every direction often evidently from a great distance. Each as it arrives is greeted with a chorus of chattering from those already there, and often the whole gathering will rise with a roar of wings, and circle round before settling again. A deafening uproar continues till well after dark. In the morning they do not wake until the sun is fully risen, and there is less tumult, each flock taking wing independently and setting off quietly and purposefully for their chosen feeding grounds.

Breeding takes place from February to May, and probably two broods are reared. Any suitable natural hole may be used, usually in a side branch of a big tree at a great height from the ground. Only once have I found one as low as ten feet. Old barbet and woodpecker holes are equally welcome, nor need they always be old, for I have seen a pair evict a couple of Yellow-throated Sparrows, and two others having a violent quarrel with a Green Barbet and a Yellow-naped Woodpecker respectively, out of which the mynahs must have come victorious as in both cases they were in possession on my next visit. The nest consists of a pad of straw, feathers, and assorted rubbish on which are laid the two or three pale blue eggs. A young bird found fallen from the nest in my garden when placed in a cage hung from the verandah eaves was fed by its parents or another pair with the greatest boldness.

Temenuchus pagodarum : The Brahminy Mynah.

Confined entirely to the Dry Zone, and the bordering portion of the deciduous forest. In this area it is common and the predominating member of the family. They like open scrub jungle provided there are plenty of large trees, and well-wooded cultivation. Though fond of fruit when obtainable, they find much of their food on the ground, hunting grasshoppers and attending on grazing cattle for the ticks which frequent them, though not as regularly as *A. tristis.* On the ground they walk and run actively with a very erect stance. In the off-season they roost communally with other species in reed-beds. Breeding takes place in April and May after the first rains. Any natural hole in a big tree suits them, and the nest is the usual mynah collection of old rubbish. They tend to breed communally if sufficient sites close together can be found.

Acridotheres tristis : The Common Mynah.

This mynah is restricted almost entirely to open, cultivated country. It is fairly common in the Dry Zone round villages, but is not found in the scrub jungle or deciduous forest. They wander up into the Inter-Zone up to 3,500′, but again are only seen in open grazing land and round villages, and avoid coffee cultivation and any continuous woodland. These wanderers are on the best of terms with their far more numerous cousins, *Aethiopsar fuscus*, and join their flocks and roosts freely. While fond of fruit and nectar when obtainable, the bulk of their food is found on the ground and they are constant attendants on grazing cattle for the ticks and flies which infest them and the grasshoppers and other insects which they kick up. I have no data on the breeding of this mynah, but as far as I can make out those which visit the Inter-Zone are merely winter migrants returning to the Dry Zone to nest. My remarks under this species in my original Notes on the

Birds of Coorg should in fact refer to *A. fuscus* and not the present bird.

Aethiopsar fuscus: The Jungle Mynah.

Exceedingly common all through the Inter and Wet Zones wherever there is cultivation, but absent from the highest hills and all continuous evergreen forest. They occur in smaller numbers through the deciduous forest, turning up in clearings and plantations and are not uncommon in the scrub jungle and light woodland of the Dry Zone. In habits they closely resemble *A. tristis*, and the two are generally so similar that there seems very little justification for assigning them to separate genera.

They are catholic in their feeding tastes, taking all sorts of fruit, berries and insects, as well as nectar. Round habitations they are almost as arrant scavengers as the crows. Though to a great extent social while feeding, they tend to spread out in pairs over a wide area, assembling in flocks in the evening to fly to a common roost often at a considerable distance.

This is the only species which I have seen indulging in the peculiar habit of ' anting '. Two birds were watched sitting on the ground in a most unusual attitude, leaning back on their outspread tails with the wings half open, and picking up small black ants and applying them to their axillae.

Breeding extends from March till June with its peak in April and May. Any natural hole may be used at any height from six feet upwards. The favourite sites are undoubtedly the isolated pollarded trees on village grazing grounds where every suitable hole will be found to be occupied. Competition is keen and weaker species such as hoopoes are ruthlessly evicted. The nest is the usual pile of rubbish often in very large quantities if the hole is a big one. One bird deceived me. On several occasions I put her out of the nest but each time on feeling in could only detect lining. At last on removing some of this I found the eggs buried underneath and almost ready to hatch. Apparently she covered them each time before leaving. They are prolific birds ; one raised a family of six in March, and there was a second brood of four in the same nest in the following May. Four or five is the normal clutch though six is not uncommon.

Ploceus philippinus: The Baya Weaver.

The Baya is found as a breeding bird in the Inter and Dry Zones, differing considerably in habits in the two biotopes. In the Inter-Zone it is entirely dependent on paddy cultivation. Numbers are small and colonies, which will be found on trees and bamboos on the borders of paddy fields, seldom exceed ten completed nests, and are often a mere half dozen or so. There is only one crop of paddy in Coorg except in a few small areas, and this is planted as soon as the rains break in June. The Bayas, who have been conspicuous by their absence all through the hot weather and early monsoon, appear about the beginning of September when the paddy is a foot high and at once begin breeding operations. They are very erratic in their visits. A colony in one stretch of fields one year is no indication that they will be there next season, or indeed anywhere within a considerable distance. Many weak colonies are started, and then abandoned. Presumably the isolated males that begin them fail to attract mates and go elsewhere. The only materials used in the nest are thin strips of paddy leaf. The bird nips the leaf to the required width and then flies off, tearing away a strip as it goes. The male does all the external building. As soon as the main body of the nest is completed, the female, if she approves of it, occupies it and begins to lay. I am not certain whether it is not she who adds the lumps of mud which are always found plastered onto the walls of the interior. The male continues the entrance tunnel while incubation proceeds and then goes on to build fresh nests. Many are never completed, and numbers in various stages will usually be found on the ground below, apparently cut down by the birds themselves for some reason. Breeding goes on until the end of October after which the males go into eclipse, and the birds unite in flocks and remain in the neighbourhood until the paddy is cut, feeding on the ripening grain. After January they leave the district, and the latest record I have is February 13th.

In the Dry Zone they are much more numerous and the colonies far stronger, 25 to 50 occupied nests being common. In this area paddy is not grown, and the birds breed on the edges of tanks and streams, nearly always in trees overhanging water, and make their nests of strips of reed or the prevailing grain, 'Ragi' (*Eleusine*). Breeding takes place earlier here, in June, July and August, the period of maximum rainfall. The grain crops are harvested in early September, and by mid-October the Bayas disappear. In some years when there is a good autumnal N. E. monsoon a recrudescence of breeding activity takes place in October/November. Two eggs are the normal clutch.

Ploceus manyar: The Streaked Weaver.

A common breeding bird in the Mysore maidan where every village has its tank. In Coorg however, there is such a small proportion of Dry Zone country of this type that there is only one tank of any size and not more than half a dozen which fulfil the necessary requirements of this bird. These consist of mainly strong stands of bulrushes growing in fairly deep water. I only know definitely of two breeding places and these are only used in years of good rainfall when there is plenty of water and the rushes make good growth. In such favourable seasons the colonies are large, fifty or sixty pairs at least. Most nests are built on the fringe of the beds, on the edge of open water. The tips of a number of reeds are firmly lashed together and woven into the top of the nest which lacks the suspensory neck of the Baya's. As in the case of that bird, the upper part of the nest is first completed and then the rim of the cup is woven forming a stirrup.[1] At this stage the nest looks like a helmet with chinstrap. Whereas in the Baya's nest a few lumps of mud are added at random internally, the Streaked Weaver, while the nest is still at this stage regularly plasters a definite band of mud half an inch wide all along the nape of the helmet. The cup is then added and the eggs laid. Sometimes no entrance tunnel at all is made. Usually however a short tunnel is built on during incubation. It is seldom more than six inches long, though I have seen one of a foot. Three is the usual clutch.

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[1] In the case of the Baya surely the 'stirrup' or 'chinstrap' is the first portion to be completed after the initial attachment to a twig, extensions from the two sides of which form the 'helmet'.—EDS.

As with the Baya, a Streaked Weaver colony at the height of the season presents an extremely busy and noisy scene. The males dash to and fro with strips of rush, or perch on the reed tops, fluttering their wings and displaying their golden crowns, chattering excitedly especially when any female appears.

The rushes are usually sufficiently tall by early July, and from then on until September nesting continues. After the season is over, the birds disappear, and like the Bayas their subsequent movements are unknown to me.

Munia malacca: The Black-headed Munia.

This bird is a constant associate of *Ploceus manyar*, and where one occurs the other is sure to be found. It is an essentially waterside species at any rate in the breeding season. I have never seen them in Coorg except when nesting, nor have I seen them in winter on the large Mysore tanks where the reeds remain throughout the year. They begin to arrive in their breeding quarters early in July, shortly after the Streaked Weavers, and building gets into its stride a fortnight later. The nests are built in bulrushes standing in water, but unlike the weavers are low down within a foot or so of water level. They are large, loose balls of bulrush leaves nine inches in diameter, woven round several reed stems. The lining consists of grass, and as with practically all species of munia, a fringe of flowering grass heads projects all round the entrance, in some particularly well-developed cases suggesting an embryo type of the weavers' entrance funnel. They breed colonially in company with the weavers though the nests are usually scattered over a wider area. One year there must have been at least fifty occupied nests with as many or more of *P. manyar* round one tank of about three acres in extent. By contrast with their neighbours the munias are quiet little birds though far from shy. I have seen them settle on weavers' nests and even go inside, but have been able to find no proof that they are in anyway parasitic. The full clutch is five or sometimes six, and as with many munias two birds may often be found incubating at once, so that it is possible that two hens may lay in the same nest. Breeding is usually over by mid-September and they disappear shortly after that time. They do not associate with the weavers while feeding, but join up in mixed flocks with other munia species, and feed on various weed seeds and often grain.

Uroloncha striata: The White-backed Munia.

The commonest munia in Coorg. They are most numerous in the Inter-Zone and in cultivated country and range up to 4,500′. They avoid continuous forest, but occur in maidans, in the deciduous jungle, and are found in small numbers in the Dry Zone. Except during the monsoon when they form large flocks they are inconspicuous little birds and I have not been able to work out their movements. A fair number must be permanently resident as I have found nests in almost every month of the year. They build in a variety of situations, but prefer gardens, orchards, and parkland, usually choosing a small isolated tree. The nest is placed among the upper or outer twigs at a height of from 6 to 20 feet, and is often quite conspicuous. It is a small, roughly built ball of coarse broad-leaved grass or bamboo leaves, lined with fine green grass whose flowering heads project round the entrance hole which is on one side. Five or six eggs are laid. The birds use the nests for roosting as soon as they are completed, and it seems likely that two females may lay in the same nest as I have on a number of occasions flushed three birds from a nest containing incubated eggs, and it is very common to find two, presumably cock and hen, sitting together. The whole family after fledging often return to roost in the nest and it is positively startling to find eight or nine of them exploding out of a nest which does not look big enough to hold half that number. Like all the family they appear to be almost exclusively seed-eaters, feeding on paddy and various other grass and weed seeds. The eggs can be distinguished from those of other munias by their long, pointed shape.

Uroloncha kelaarti: The Rufous-bellied Munia.

The range of this species more or less coincides with that of the last, but it prefers higher and wetter country, and I have never seen it in the Dry Zone, nor is it ever as numerous as the White-backed Munia. The two species frequently consort in mixed flocks to feed on paddy or wild grass seeds. They are only in evidence during the monsoon, and all occupied nests which I have seen have been found between June and August. They apparently sometimes build nests simply for roosting purposes as I have twice put a whole flock of eight or ten birds out of a nest which showed no signs of having been used for breeding. The nests are indistinguishable from those of the White-backed Munia and are built in similar situations. Broad-leaved grass is largely used and one may see a bird flying along with a piece as wide as itself and twice as long which practically hides it.

Uroloncha malabarica: The White-throated Munia.

I have only seen this species on a few occasions. Coorg is really out of their range but odd pairs stray into the Dry Zone from the adjacent Mysore Maidan, and I have found a nest in mid-June six feet up in a solitary thornbush on a rocky, scrub-grown ridge rising out of typical Dry Zone cultivation. It was the usual untidy munia ball of grass with the distinctive grass-flower entrance fringe.

Uroloncha punctulata: The Spotted Munia.

This munia which is the common species on the Nilgiri plateau at high elevations, strangely enough is not found anywhere in Coorg except in the Dry Zone where it is not uncommon in cultivated areas and wasteland grown with light scrub. I have not found the nest in Coorg, but those I have seen in the Nilgiris were quite typical munias nests built in small trees from 6 to 10 feet from the ground.

Amandava amandava: The Indian Red Munia.

An uncommon species which I have only met on a few occasions in the Dry Zone usually in small flocks in company with other munias. I saw a female carrying building material on Oct. 10th., but she disappeared in the long grass bordering a paddy field, and I was unable to find the nest. On the same date some years later I found a nest low down in a thorn bush within two feet of the ground which probably belonged to this species as I flushed one a few feet away, and the site was an unusual one for any of the other munias. The nest which was new but empty was a typical munia's in every way including the entrance fringe.

Carpodacus erythrinus: The Common Indian Rosefinch.

Common winter visitors. They arrive late, seldom appearing before November, and are found in flocks of twenty or thirty in fairly open country, grazing lands, cultivation, or the borders of jungle. They appear to be largely frugivorous and may often be seen feeding on nectar on flowering trees.

Gymnorhis xanthocollis; The Yellow-throated Sparrow.

Very common throughout the year in the Dry Zone. They are to be found in the Inter-Zone during the dry season and breed there, but appear to migrate during the monsoon. In the Dry Zone they are found in cultivated country, but they are much more jungle birds than *Passer domesticus*, and are equally at home in light, open forest, or scrub scattered with ancient trees whose gnarled and hollow limbs provide nesting sites. They occur through the deciduous forest in clearings and plantations. In the Inter-Zone they are most numerous in the open grazing grounds with their scattered trees, but also may be seen in thickly-shaded coffee plantations. In the Dry Zone they tend to breed colonially if suitable sites exist and the nests may be quite low down. In coffee plantations they nearly always choose an old barbet hole or natural hollow in an outlying limb of a dead tree, at a great height and usually quite inaccessible. The nest is a small pad of hair, feathers and grass. The site is given away by the male, who spends the greater part of the day sitting nearby, chirruping loudly and monotonously. The hen does all the building, the cock merely accompanying her in her search for material.

Passer domesticus: The Indian House Sparrow.

Occurs throughout Coorg but is nowhere numerous and is confined entirely to the towns and larger villages, and will rarely be seen more than a hundred yards away from human habitations. In habits it resembles the species the world over. Breeding appears to go on intermittently all the year round, and the nests are the usual untidy bundles of straw and feathers tucked into a hole in the thatch or under the eaves or on the rafters of some building.

Riparia rupestris; The Crag Martin.

I have seen this bird in large numbers in company with *R. concolor* hawking round the cliffs of Cottabetta, a hill some 5,500′ high in N. Coorg in March, and again at Mercara, 4,000′, in November. I take it that they are regular winter migrants to the higher crags and precipices of the Ghats.

Riparia concolor: The Dusky Crag Martin.

A regular resident on all the higher and rockier hills of the province, though nowhere in very large numbers in any one spot. They are quiet little birds, which spend their lives flitting up and down the face of some rock wall, uttering a soft, mouse-like cheep. They are not entirely confined to cliffs, however, as they are sometimes to be found in the neighbourhood of towns and villages such as Somwarpet and Mercara in the hillier parts of the country. Here they breed in temples and other large stone buildings, and they turn up again in the Dry Zone on high, isolated rock outcrops. They are early breeders, beginning about the end of January. They are not social in habits, the nests being built singly against a rock face, usually close under an overhanging ledge. They are shallow cups of mud, open at the top and lined copiously with feathers. In the case of one site which has been used to my knowledge for at least five years in succession, the owners seemed to have a predilection for green feathers which always constituted a major portion of the lining. Several broods are raised in a season, and as the mud cup is usually built in a spot well protected from the weather, it often survives from year to year with little repair, the lining being changed after each brood.

Hirundo rustica: The Eastern Swallow.

A common winter visitor in the Dry Zone, and also in the Inter-Zone wherever there is open country and paddy-field. From late September to March they outnumber all the other resident swallows put together.

Hirundo javanica: The Nilgiri House Swallow.

I am very doubtful about the occurrence of this bird in Coorg. My record, *vide* Eastern Ghats Survey, was almost certainly an error. The birds in question, in the light of subsequent experience, were probably *R. concolor*.

Hirundo daurica: The Striated Swallow.

A resident species though nowhere seen in large numbers. They are most numerous in the Dry Zone in cultivated country, but they are also found in the Inter-Zone in open areas where large tracts of paddy land occur, as round Virajpet and Ponnampet in S. Coorg. In the winter they flock and wander beyond their usual range in company with *H. rustica*, though these may possibly be a migrant northern subspecies. During the breeding season they are not sociable, and though one or two pairs may occasionally be found nesting in company, as a rule they build singly. For breeding purposes a horizontal stone slab on the underside of which they can cement their nests seems to be a *sine qua non*. Road culverts provide by far the commonest sites, followed by the sluiceways of tanks and the small stone-built Hindu temples which are frequent in the Dry Zone. Breeding seems to depend largely on the rainfall, as they are by no means waterside birds, and until water is obtainable they cannot start work. The day after the first shower of the year, be it in March, April, or May sees them furiously at work, collecting mud from the nearest puddle. They do not go far to fetch it, presumably because it would dry on the way and be of no use. The nests are hemispheres six inches in diameter with the entrance prolonged into a funnel, an inch and a half wide and six or seven inches long, and often by no means straight, running out at one side like a giant termites' gallery. The whole consists of mud firmly cemented to the stone, and there is a copious lining of feathers. Breeding goes on throughout the monsoon at intervals, the same nest being used again after repairs and relining. The only clutch record I have is three.

Hirundo smithii : The Wire-tailed Swallow.

This is essentially a waterside bird. They are found on all the larger rivers and tanks of the Province, from the rapid torrents running through forest-clad ravines at the foot of the Ghats only a few feet above sea-level to the broad stretches of the Cauvery flowing in the open, cultivated country of the Dry Zone. They spend their time hawking over the wider pools, and rarely leave the rivers except in the monsoon spates when they take to the flooded paddy-fields on the banks. Nesting begins in January and continues until the rivers rise in June or July. The nests are, in my experience, invariably built over water, seldom more than six feet from the surface, and often within a foot of it. Large numbers must be destroyed by sudden floods. The sites chosen are various ; overhanging rock ledges, the underside of fallen trees, culverts, sluices or boat-houses, but they are always in a position sheltered from above. They are small, shallow saucers of mud with a scanty lining of feathers and sometimes straw. Three eggs are laid, sometimes four. I do not know whether the male broods. He certainly helps to feed the young. The latter continue to use the nest even when they are strong on the wing and more or less independent of their parents, but after a week or so they are driven off when the latter begin to think about raising another brood. The old lining is removed and a fresh one added, but the mud cup is untouched though its exterior is often in a filthy condition from the droppings of the young birds. At least two and probably three broods are reared annually.

(*To be continued*)

NOTES ON BUTTERFLIES FROM NEPAL

BY

LT.-COL. F. M. BAILEY, C.I.E.

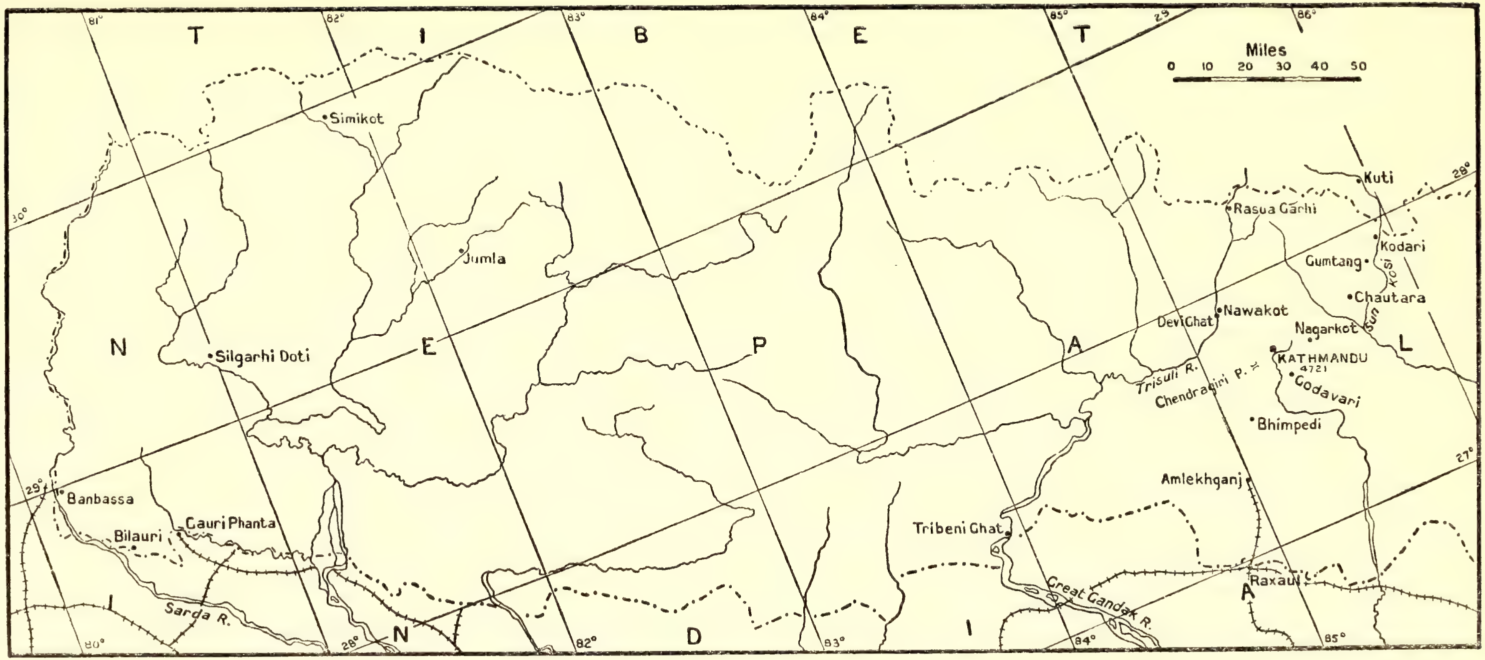
PART I

(*With a map and two plates*)

Nepal lies for five hundred miles along the southern face of the Himalayas, extending south of the foothills for a few miles into the plains. This extension is the Terai. In the localities given for species, and more especially for sub-species, in Evans's 'Identification of Indian Butterflies' we constantly come across 'Kashmir to Kumaon' for a western form, and 'Sikkim to Karens' or 'Dawnas' for the eastern. This is mainly a question of rainfall which necessarily affects vegetation and all forms of life. The annual rainfall of Sikkim in the east is about double that of parts of Kumaon in the west. Thus Nepal constitutes a strip of some five hundred miles dividing the western from the eastern forms, and, I hope, from this collection to find out where these changes occur. The differences of local races are in many cases very small, and it is often difficult to determine to which form the specimens in the intermediate area belong. As the butterflies of Nepal are little known, the result has been an extension of habitat of many forms from Kumaon eastwards and from Sikkim westwards. I have indicated this by an (E) or (W) as the case may be.

The saucer-shaped Nepal Valley is about fifteen to twenty miles in diameter. The general elevation above sea-level is about 4,300 ft. The rim of the saucer rises to 9,000 ft. The rivers outside this curious circular elevation flow at about 1,500 ft. The floor of the valley is densely cultivated with rice, maize and in winter barley and wheat. Potatoes and other vegetable crops are also grown. The valley is thickly populated. In the valley are some woods and wooded hillocks. The capital, Katmandu, several other towns and the British Embassy are also in the valley. The surrounding hills are covered in thick forest with areas of short turf and bushes. On these hills are two places, Kakni and Nagarkot, each about 6,000 ft. above sea-level, where the Prime Minister maintains guest houses which he kindly allowed the British Minister to occupy. The climate here was fresher than the damp heat of the valley, especially in late summer. In the south-east of the valley is a place called Godavari where H. H. The Prime Minister has a palace. Here the woods and streams were a relief from the flat valley although the altitude was very little higher. Several interesting species were found here among the gardens and rivulets.

This is the area to which the members of the British Legation were confined when this collection was made. The 'Valley' in the following pages refers to this area. There was one exception to this restriction of travel: the Minister was allowed to go to Devighat on the Trisuli River, a day's march from Katmandu outside the valley to the north, where there was mahseer fishing. The altitude was 1,500 ft. The journey to and from Raxaul, the railway station in India, also gave



NEPAL

(Showing the principal Localities where Butterflies were collected.)

opportunities for collecting at lower elevations. Places on this road were: Chandragiri (on the rim of the saucer 7,700 ft.), Chitlang, Bhimpedi, and Amlekganj.

In addition to the above the British Minister was allowed to shoot in the Terai, the belt of land in the plains below 1,000 ft. in altitude running up to the foot of the mountains. This was extensively cultivated, but also contained much natural forest with tall grass especially in the stream beds, the haunt of wild elephants, rhinoceros, buffaloes and tigers besides deer and many other animals. The Terai was only visited in winter. These are the localities in which I was able to collect personally during the three years 1935 to 1938 in which I was in Nepal.

Besides these places in which I collected myself, I sent collectors to other parts of the country. For this purpose I trained two Nepalese boys, not only in collecting butterflies but also birds, plants and small mammals. In the summers of 1935 and 1937 these collectors visited the country north of Katmandu while in 1936 they were sent to western Nepal and visited the Tibetan frontier. They did not bring anything from the high Tibetan Plateau as the Tibetans would not let them collect there. A special purpose of sending them here was to obtain specimens of the Mountain Quail (*Ophrysia superciliosa*), a bird which had not been seen since 1876. They were not successful in this. I found that the collectors were unreliable in the use of an aneroid therefore no altitudes are given for specimens collected by them.

There are a few specimens in the British Museum labelled 'Nepal' but no indication as to who collected them. However, in the preface to Moore's 'Lepidoptera Indica', the author acknowledges specimens collected by Maj-Gen. G. Ramsay when he was Resident in Nepal from 1852 to 1867. Ramsay's notes on his collections were recorded in the *Proc. Zool. Soc.* in 1874, '77, '78 and '83. A large collection of butterflies was made by Major W. G. H. Gough; his list was published in Vol. 38 of the *Journal.* He records 162 species and sub-species, almost all of which were collected in the valley and on the surrounding hills. As he did not emphasize the extension of habitat I have included those in Gough's list when indicating an extension (E) and (W). A few specimens taken before 1934 are from the collection of Col. W. Smith who was Legation Surgeon.

All species have a reference number to Brigadier Evans's 'Identification of Indian Butterflies', 2nd. Revised Edition. Besides this a reference has also been given to Talbot's 'Fauna of British India' which was published after Evans's 'Identification'. This only deals with Papilionidae, Pieridae, (published in 1939), and Danaidae, Satyridae, Amathusiidae and Acraeidae (published in 1947). In the Hesperiidae a further reference is given to Evans's 'Catalogue of the Hesperiidae from Europe, Asia and Australia in the British Museum' 1949. Brigadier Evans has kindly looked over the list of Hesperiidae and checked the names.

PAPILIONIDÆ

1. **Troides helena cerberus** Fd.
   Talbot F.B.I. 1c; Evans 1. 1.
   Much less common than *Aeaeus.*
   Katmandu, June to September.

2. **Troides aeacus aeacus** Fd.

Talbot F.B.I. 2; Evans 1.2.

Common in the Valley in May and June; particularly plentiful at Godavari in June.

Gui-ye, North Central Nepal 20–5–37.

3. **Polydorus aristolochiae aristolochiae** Fab.

Talbot F.B.I. 12a; Evans 2.10.

Katmandu, 4,300 ft. March and May.

4. **Polydorus latreillei latreillei** Donovan.

Talbot F.B.I. 14a; Evans 2.12.

Valley up to 5,500 ft. May to July.

5. **Polydorus philoxenus philoxenus** Gray.

Talbot F.B.I. 17a; Evans 2.15.

Valley, April to August.

6. **Polydorus dasarada ravana** M.

Talbot F.B.I. 18a; Evans 2.16.

Nepal Valley, May.

A few brought in from the north, in May 1935 and May 1937.

7. **Polydorus plutonius pembertoni** M.

Talbot F.B.I. 20a; Evans 2.18.

Three specimens: Valley, May 1937; Gui-ye, North Central Nepal 20–5–37; Nangang, West Nepal, 26–5–36.

8. **Chilasa agestor agestor** Gray.

Talbot F.B.I. 21a; Evans 3.1.

Rare—only two specimens; Katmandu 30–3–34 and 1–5–35.

9. **Chilasa epycides epycides** Hew.

Talbot F.B.I. 22a; Evans 3.2.

Valley, only in March and April.

10. **Chilasa clytia dissimilis** L.

Talbot F.B.I. 25a; Evans 3.5.

Morang, East Terai, 24-3-36.

11. **Papilio memnon agenor** L.

Talbot F.B.I. 27; Evans 4.2.

Valley, March to October, frequently at damp sand: Katmandu ♀ *agenor* form, Oct. 1933; Katmandu ♀ *alcanor* form, Oct. 1933; Devighat 1,500 ft. 25-10-35; Nangang, North Nepal 26-5-35; Kashiganj 7-8-35.

12. **Papilio bootes janaka** M.

Talbot F.B.I. 29.a; Evans 4.4.

Valley, up to 5,000 ft., April to June; Kodari, North Nepal, 21-5-37; Nangang 26-5-35.

13. **Papilio rhetenor rhetenor** Wd.

Talbot F.B.I. 30a; Evans 4.5.

Valley and surrounding hills to 7,000 ft. March to August; Nagarkot, 7,000 ft. 7-8-36. ♀

14. **Papilio protenor euprotenor** Fruh.

Talbot F.B.I. 31b; Evans 4.6.

Valley and surrounding hills to 7,000 ft. March to September.

Larvae found on *Zanthoxylum alatum* Roxb. (Rutaceae) at Nagarkot, 6,000 ft. Pupated in autumn and emerged at Katmandu on dates between 15th February and 11th March.

A pair were taken *in copula* at Sunderijal in the Valley on 4-7-36.

15. **Papilio polyctor ganesa** Db.

Talbot F.B.I. 35b; Evans A. 4.9.

Common on the hills above the Valley which rise to 7,000 ft.

The larvae were plentiful on *Zanthoxylum alatum* (Rutaceae) at Nagarkot between 5,000 and 7,000 ft.; they were brought down to Katmandu (4,300 ft.) where pupations of late autumn mostly emerged in April. There were three early emergences at the beginning of March. A few emerged in August and a single one which pupated on the 25th of August emerged the same year on the 5th of October.

Many pupae were destroyed by parasites.

16. **Papilio paris paris** L.

Talbot F.B.I. 36b; Evans. 4.10.

Valley 3,000 to 5,000 ft. April to September.

17. **Papilio arcturus arcturus** Wd.

Talbot F.B.I. 37b; Evans. 4.11.

Sundarijal, Valley 5,500 ft. 3-8-36; hill above Kakni, 7,500 ft. 15-9-37.

Not common. [Larvae in Kashmir were found on *Skimmia* (Rutaceae).]

18. **Papilio helenus helenus** L.

Talbot F.B.I. 45a; Evans 4.19.

Valley, March to October. One emerged at Katmandu on 23-3-38.

19. **Papilio chaon chaon** Wd.

Talbot F.B.I. 47a; Evans 4.21.

One specimen at Bhimpedi, about 1,000 ft. below the Valley.

20. **Papilio polytes romulus** Cr.

Talbot F.B.I. 51 a; Evans 4.25.

Common in the Valley from March to November; particularly plentiful in early April. Larvae feed on orange trees. Most females are of form *stichius* Hub. mimicking *P. aristolochiae*, but there are several of form *romulus* Cram. mimicking *P. hector*, a butterfly which was never found in the Valley.

21. **Papilio demoleus demoleus** L.

Talbot F.B.I. 54a ; Evans 4.27.

The commonest *Papilio* in the Valley where the larvae do appreciable damage to orange trees. This butterfly was seen every month of the year except January and February.

Autumn pupations emerged at the end of March. Pupae suffered very much from parasites.

22. **Papilio machaon emihippocrates** Verity.

Talbot F.B.I. 56e ; Evans 4.29.

A few were taken in the Valley and on the surrounding hills (4,300 to 7,000 ft.) Some at Devighat 1,500 ft.

Four larvae were found on fennel [*Foeniculum*, (Umbelliferae)], in the Legation garden at Katmandu. All these pupated on 15-11-36 and two emerged on 8-4-37 and one on 1-5-37. Several brought down from the Tibetan frontier were the short-tailed *ladakensis* M. (Kuti 6-6-37, Balwa 12-6-37 and 25-9-37.)

23. **Graphium euros sikkimica** Heron. (W)

Talbot F.B.I. 58b ; Evans 5.1.

Valley, March to early May, not common.

24. **Graphium nomius nomius** Esp.

Talbot F.B.I. 61a ; Evans 5.4.

Common on damp sand at Amlekganj below the Valley, 1,000 ft. 24-4-38. This is an extension of habitat westwards in the Himalayas.

25. **Graphium cloanthus cloanthus** Wd.

Talbot F.B.I. 64 ; Evans 6.1.

Common in the Valley. In company with *Teinopalpus imperialis* flies round isolated hilltops.

26. **Graphium sarpedon sarpedon** L.

Talbot F.B.I. 65b ; Evans 6.2.

Common in the Valley, March to October. Females were seen depositing eggs on 18-6-37 and 14-8-37. These last eggs hatched out on 19-8-37 and the butterflies emerged on 13-10-37, 6-3-38 and 9-3-38. In these specimens the green bar across the wings is of a light greenish yellow and lighter than in wild caught specimens. It would appear that the female never deposits more than one egg on a bush. It seems necessary for the female to wait and make a short flight between depositing each egg. I was able to get several eggs by pulling up the bush on which an egg had been laid and running down the pathway through the forest, when the butterfly would deposit another egg on the same bush in my hand and in this way I obtained several eggs.

27. **Graphium doson axion** Fd.

Talbot F.B.I. 66 c ; Evans 6.3.

One specimen in the eastern Terai on 26-3-36 at about 1,000 ft.

28. **Graphium bathycles chiron** Wallace.

Talbot F.B.I. 69 ; Evans 6.6.

Valley, March and April. Rare.

29. **Graphium agammemnon agammemnon** L.

Talbot F.B.I. 71a ; Evans 6.8.

Valley, March to September. Larvae were found on Magnolia and the butterflies emerged between 23rd and 28th September 1935.

In Central India I found this butterfly depositing eggs on *Michelia champaca* (Magnoliaceae).

30. **Graphium gyas gyas** Wd. (W)

Talbot F.B.I. 75a ; Evans 8.1.

Only two worn specimens taken at Godavari in the Valley on 29-4-36 and 3-10-37.

31. **Teinopalpus imperialis imperialis** Hope. (W)

Talbot F.B.I. 79a ; Evans 9.

Locally fairly plentiful on Mahadeo Pokri Hill 7,400 ft. at Nagarkot above the Valley. Accounts of the habits of this splendid insect state that it flies round the tops of high trees. The hill of Mahadeo Pokri had been cleared of trees for survey purposes and in their places bushes up to ten feet high had grown. This had the effect of a high tree top. The male butterflies flew fast round this hill and descended to rest on the low bushes. Other butterflies flying with it were *Graphium cloanthus* and *Hestina nama*. Thinking that *Teinopalpus* did not occur west of Sikkim I at first thought this butterfly, when seen on the wing, was a torn specimen of *G. cloanthus*, when to my surprise it settled with great suddenness on a leaf in front of me and I was able to recognise and photograph it.

An account with photographs of this butterfly in Nepal was published in the *Journal of the Bengal Natural History Society*, Vol. XIV, No. 4, pp. 123 and 124.

At first these butterflies were very wild and flew away at my approach, flying round for a few minutes before returning to nearly the same spot. After being disturbed a few times they seemed to get tired of this and eventually I was even able to touch them without frightening them away.

32. **Parnassius hardwickei hardwickei** Gray.

Talbot F.B.I. 86a ; Evans 13.4.

Many brought in by collectors, May to September.

PIERIDAE

33. **Leptosia nina nina** Fab.

Talbot F.B.I. 95 ; Evans 1.

Valley, 14-8-37. Rare.

Common in the western Terai, December and January.

34. **Pieris napi montana** Verity.

Talbot F.B.I. 137b ; Evans 4.7.

A few specimens in June 1937 from Kuti and Chosang on the Tibetan side of the Nepal-Tibet border in the west.

35. **Pieris canidia indica** Evans.

Talbot F.B.I. 141b; Evans 4.10.

Common in the Valley and brought in from other parts of Nepal; also from the Terai in winter.

Pairs were taken *in copulae* on 16-3-35, 15-10-35, 1-11-37, and 1-12-27 Eggs were laid on garden stock on 1-3-35 ; these hatched on 11-3-35 but the larvae seemed unable to eat the thick leaves and all died.

The full grown larvae are green with fine white hairs on the tip of which are minute drops of a colourless liquid.

36. **Pieris brassicae nepalensis** Db.

Talbot F.B.I. 142 ; Evans 4.11.

Common in the Valley and throughout the country to which collectors were sent.

37. **Aporia agathon agathon** Gray.

Talbot F.B.I. 102d ; Evans 5.5.

Very plentiful on the hills surrounding the Valley and the woods at Godavari and other places in the Valley. On 1-6-35 a female was seen depositing eggs on Holly Berberis (*B. asiatica*, Berberidaceae) in deep forest. No eggs were found on Berberis in open sunlight. Eggs were laid in batches. Eighty-eight were counted in one batch and most batches were about this size. Larvae hatched between the end of June and up to the 9th of July. The young larvae eat the centre of the leaves.

Specimens of *A. agathon caphusa* M. were brought in from western Nepal in May and June 1936.

38. **Delias agostina agostina** Hewitson.

Talbot F.B.I. 113 ; Evans 6.1.

One specimen at Katmandu, 4,500 ft. 15-4-34.

39. **Delias eucharis** Drury.

Talbot F.B.I. 114 ; Evans 6.3.

Only in the Terai.

40. **Delias hyparete indica** Wallace.

Talbot F.B.I. 115b ; Evans 6.4.

One in the Valley and two brought in by collectors in July and November from the country north of the Valley.

41. **Delias belladonna horsfieldi** Gray.

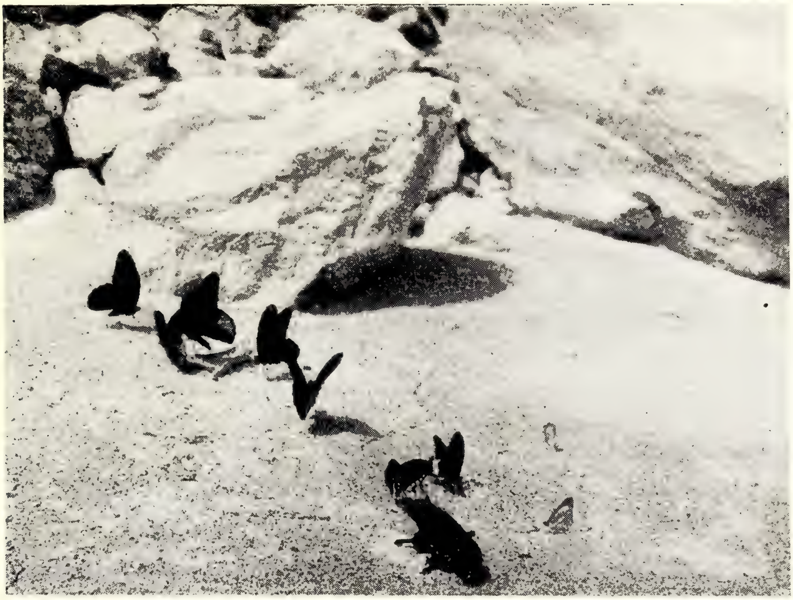
Talbot F.B.I. 109a ; Evans 6.7.

Very plentiful in April and May in the Valley where it is found in great numbers at moisture. An autumn brood appears in August to November, but is not so plentiful.

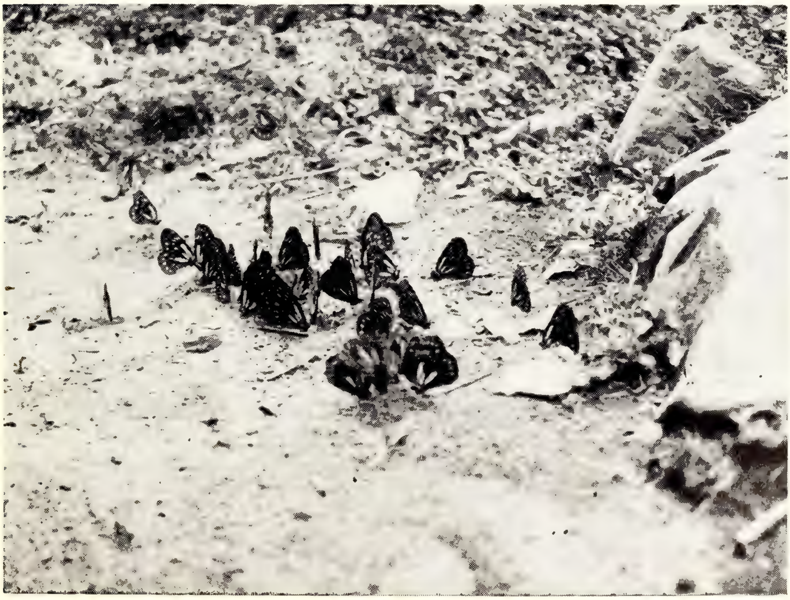
A pupa was found fastened to the upper side of Holly Berberis (*Berberis asiatica*). This emerged on 17-8-35.

42. **Delias sanaca sanaca** M.

Talbot F.B.I. 107 ; Evans 6.9.



Papilios on wet sand—*Papilio memnon agenor, polytes* and *paris* (or *ganesa* ?) can be recognized—also *Cepora nadina*.



Photos Author

Aporia agathon at Godavari, Nepal Valley, 7-5-1936.

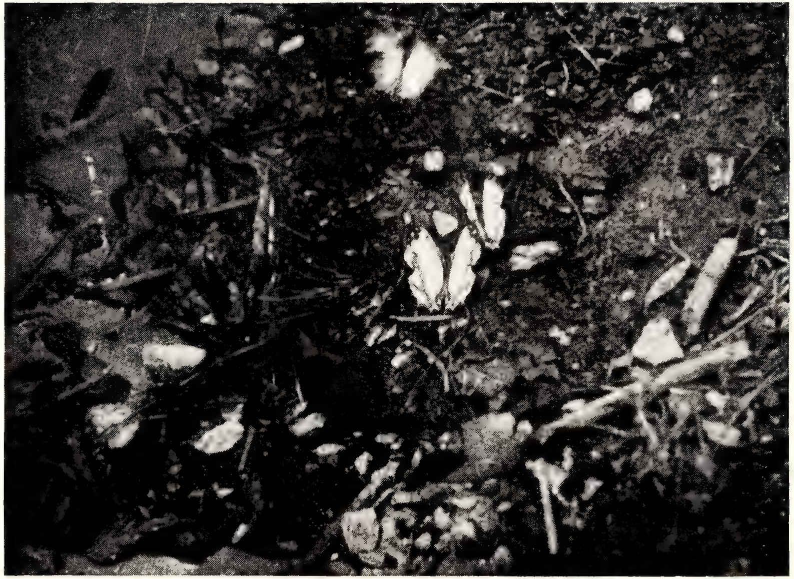


Photo Author

Cyrestis thyodamas at Godavari, Nepal Valley, 8-5-1937.

Two specimens from West Nepal (Pomo 15-6-36, Nilkarda 13-6-36) are *sanaca sanaca*. One from Barai, West Nepal 14-6-36 approaches *sanaca confusa*. *D. sanaca oreas* is from North Nepal: Trisuli 1-6-35; Karai 19-5-35 and Kodari 1-6-37.

43. **Delias berinda boyleae** But.

Talbot F.B.I. 108a ; Evans. 6.10.

Common at Katmandu and Godaveri up to 5,000 ft. in May and a few in June. One at Nagarkot 6,000 ft. 7-6-37 and one at Kodari, North Nepal, 1-6-37.

44. **Delias descombesi descombesi** Boisduval.

Talbot F.B.I. 112 ; Evans 6.11.

Two specimens: Nagarkot 7,000 ft. 12-7-35; Katmandu 4,500 ft. 29-4-35.

45. **Delias aglaia aglaia** L.

Talbot F.B.I. 110a ; Evans 6.12.

Devighat 1,500 ft. 27-10-35 ; Kajuri 24-11-35 ; Galchi 5-11-36.

46. **Delias thysbe pyramus** Wallace.

Talbot F.B.I. 111a; Evans 6.13.

A few at Katmandu, March and August; Devighat 1,500 ft. 15-12-35; Bhimpedi 2,000 ft. 21–7–36.

47. **Anapheis aurota aurota** Fab.

Talbot F.B.I. 122b ; Evans 8.

Katmandu 3-5-37, 20-6-37 ; Nagarkot 7,500 ft. 14-6-37; Devighat 1,500 ft. 25-12-35.

48. **Cepora nerissa phryne** Fab.

Talbot F.B.I. 117a ; Evans 9.2.

Katmandu April, May and June. August specimens are *nerissa nerissa* Fab. A single specimen on 4-9-37 is dry-season form *copia* Wall. At lower elevations Amlekganj and Bhimpedi about 1,000 ft. this insect is commoner than further in the hills. A pair *in copula* at Chitlang 5,000 ft. 14-6-36.

49. **Cepora nadina nadina** Lucas.

Talbot F.B.I. 118c ; Evans 9.3.

Only obtained from the Terai. Two specimens at Tribeni on 12-1-36 are the dry-season form *ambā* Wall.

50. **Appias lalage** Doubleday.

Talbot F.B.I. 124a ; Evans 10.2.

Scarce. Nagarkot 7,000 ft. 6-6-37 ; Godavari 4,500 ft. 17-4-38.

51. **Appias lyncida eleonora** Boisduval.

Talbot F.B.I. 127c ; Evans 10.5.

A few at Katmandu, October and November. Godavari 8-10-36.

52. **Catopsilia crocale crocale** Cramer.

Talbot F.B.I. 165; Evans 11.1.

One female specimen from Katmandu 4,500 ft. form *jugurtha* Cram.

53. **Catopsilia pomona** Fab.

Talbot F.B.I. 166; Evans 11.2.

One female specimen at Katmandu 4,500 ft. 24-8-35 form *catilla*. Several at lower elevations including the Terai, December and January. Amlekganj 1,000 ft. 15-11-35.

54. **Catopsilia pyranthe pyranthe** L.

Talbot F.B.I. 168; Evans 11.4.

Two specimens at Katmandu 4,500 ft. 4-9-36 and 27-10-37. Plentiful at lower elevations especially at Devighat 1,500 ft. Larva on *Cassia laevigata* (Leguminosae). At the end of October and early November great numbers of larvae were pupating on the back of the leaves of the food plant, others were emerging and mating.

55. **Catopsilia florella gnoma** Fab.

Talbot F.B.I. 169; Evans 11.5.

Three specimens at Katmandu 4,500 ft. 7-4-38 and 7-7-38. Nagarkot 6,000 ft. 8-8-35. Very many at Devighat where the perfect insects were emerging at the end of October and early November. Pairs *in copula* on 27-10-35 and 30-10-35. The food plant is *Cassia laevigata* (Leguminosae). This insect flies with *C. pyranthe* in great numbers and the larvae feed on the same plant.

56. **Gonepterix rhamni nepalensis** Doubleday.

Talbot F.B.I. 172b; Evans 14.1.

Common in the Valley and on the surrounding hills. Katmandu 4,500 ft. May to November. On the surrounding hills up to 6,500 ft. late June to mid-August when there were a great many at Kakni. One brought in from Tsari on the Tibetan border, 14-6-36.

57. **Gonepterix mahaguru mahaguru** Gistel. (E)

Talbot F.B.I. 174a; Evans 14.3.

A few in the Valley; one at Kakni 7,000 ft. 15-4-37, and one brought in from Surjekunda 11-9-35.

58. **Eurema brigitta rubella** Wallace.

Talbot F.B.I. 176; Evans 15.1.

A few at Devighat, April and September, and a pair *in copula* 30-10-35. Baklore, Terai 4-4-36. A specimen brought from the Tibetan border, Laptang, 22-6-37.

59. **Eurema laeta laeta** Boisduval.

Talbot F.B.I. 177a; Evans 15.2.

Common everywhere in the Valley and on the surrounding hills up to 7,000 ft. at Devighat 1,500 ft. and in winter in the Terai. Wet season forms June to September. Dry season forms in May, October and in winter in the Terai. One wet season form was taken at Devighat on 25-11-35.

60. **Eurema blanda silhetana** Wallace.

Talbot F.B.I. 178a; Evans 15.4.

Katmandu May, August and October. Devighat 1,500 ft. 15-1-35.

61. **Eurema hecabe fimbriata** Wallace.

Talbot F.B.I. 179c; Evans 15.5.

Very common in the Valley and on the surrounding hills during April and May and again from July to November. In the Terai December to February. Pairs were taken *in copula* 2-9-37 and 3-10-35.

62. **Colias erate erate** Esper. (E)

Talbot F.B.I. 194a; Evans 16.9.

Very common in the Valley from March to October, but never found on the hills above the Valley. A pair *in copula* at Katmandu 13-5-35. A female seen depositing eggs 16-3-35

63. **Colias electo fieldii** Ménétries.

Talbot F.B.I. 199; Evans 16.14.

Very common in the Valley and on the surrounding hills in March, April and May. A few in the Valley as late as October. Many brought in from the north and north-west of Nepal, May and June. A few in the Terai in February. A pair were taken *in copula* on 7-6-35.

64. **Ixias pyrene familiaris** Butler. (W)

Talbot F.B.I. 151d; Evans 17.2.

One in the Valley 6-4-34. and two brought in by the collectors from the north, Gumar Set 2-12-35. Silagarhi, West Nepal 28-10-36.

65. **Hebomia glaucippe glaucippe** L.

Talbot F.B.I. 161a; Evans 19.

Rare in the Nepal Valley; only seen March, April and September; Devighat 1,500 ft. 18-10-35.

66. **Valeria valeria hippia** Fabricius.

Talbot F.B.I. 164; Evans 20.3.

One at Katmandu 24-3-35. Chandragiri above the Valley 5,500 ft., 28-7-35, and a few at lower elevations.

Amlekganj 1,000 ft., 2-11-36. A few in the Terai in February.

DANAIDAE

67. **Danaus aglea melanoides** Moore.

Talbot F.B.I. 213b; Evans 2.1.

Common in the Valley March to October; at Chandragiri above the Valley, 7,000 ft., 14-6-36. Also taken in the Terai in February. One taken at Katmandu on 12-7-35, had orchid pollinia on the proboscis.

68. **Danaus sita** Kollar.

Talbot F.B.I. 217; Evans 2.5.

Only two specimens from the Valley. Form *tytia* Gray 14-5-37 and form *sita* Koll. 28-3-88.

One brought in from Siligarhi, West Nepal, 29-10-36 appears to be midway between the above two forms.

69. **Danaus limniace leopardus** Butler.

Talbot F.B.I. 210; Evans 2.9.

A single female specimen in the Valley 16-3-36. Several in the Terai in winter.

70. **Danaus hamata septentrionis** Butler.

Talbot F.B.I. 211c; Evans 2.10.

A few in the Valley in March, July, August and October. Common in the Terai in November.

71. **Danaus plexippus plexippus** L.

Talbot F.B.I, 207; Evans 2.12.

Common in the Valley March to October and up to 5,000 ft. on the surrounding hills; many in the Terai in winter.

72. **Danaus chrysippus chrysippus** L.

Talbot F.B.I. 206; Evans 2.15.

Very common in the Valley from March to October and in the Terai in winter. Larvae on *Calotropis procera* (Asclepiadacae). Pupations at Katmandu on 30.4 emerging on 11.5 and on 1.5 emerging on 7.9. Other emergences in May, June and September.

73. **Euploea mulciber mulciber** Cramer.

Talbot F.B.I. 231a; Evans 3.1.

Common in the Valley except November to February. On the surrounding hills at Nagarkot 7,000 ft. June, July and August.

74. **Euploea core core** Cramer.

Talbot F.B.I. 228a; Evans 3.7.

Common in the Valley June to August, and in the Terai in winter. Emergence dates 28-6-36, 19-7-37, 23-8-35 and 14-10-35.

SATYRIDAE

75. **Mycalesis francisca sanatana** M.

Talbot F.B.I. 243a; Evans 2.5.

Common in the Valley. D.S.F. in April and May. W.S.F. April, July and August. A single specimen from Nagarkot 7,000 ft. on 7-8-36. was W.S.F.

76. **Mycalesis perseus blasius** Fab.

Talbot F.B.I. 248b; Evans 2.9.

Not in the Valley but common at low altitudes in the Terai in the winter. All D.S.F.

77. **Mycalesis mineus mineus** L.

Talbot F.B.I. 249; Evans 2.10.

Both in the Valley and in the Terai. In the Valley W.S.F. were taken from May to September and D.S.F. in June and October. D.S.F. common in the Terai in winter.

78. **Mycalesis visala visala** M.

Talbot F.B.I. 252a; Evans 2.12.

A single specimen at 5,000 ft. in the Valley on 27-10-36. A few in the Terai in midwinter.

79. **Mycalesis suavolens suavolens** W-M. and DeN. (W)

Talbot F.B.I. 260a; Evans 2.23.

Nagarkot 7,000 ft. in June and July. Katmandu 5,500 ft. 23-5-37.

80. **Mycalesis heri** M.

Talbot F.B.I. 262; Evans 2.25.

Valley, May to August. Not common.

81. **Mycalesis nicotia** Westwood.

Talbot F.B.I. 264; Evans 2.27.

Common in the Valley, May to September. A few specimens at Nagarkot 7,000 ft. in June.

82. **Mycalesis malsara** M. (W)

Talbot F.B.I. 265; Evans 2.28.

A few at Bhimpedi below the Valley 1,000 ft. early October.

83. **Mycalesis lepcha lepcha** M. (E)

Talbot F.B.I. 267a; Evans 2.30.

D.S.F. common in the Valley, March to May. One W.S.F. 5-5-37 and others in July, August and September.

84. **Lethe sidonis sidonis** Hew.

Talbot F.B.I 273; Evans 3.3.

Common in the Valley in June and October and a few in the intervening months. Also on the surrounding hills up to 7,000 ft. Specimens from North-west Nepal approach form *vaivarta* Doh.

85. **Lethe nicetella** DeN. (W)

Talbot F.B.I 275; Evans 3.4.

Three specimens only: Chandragiri 6,000 ft. above the Valley 24-6-36, 21-10-37; Godavari, 5,000 ft. 20-10-36. Always in thick forest.

86. **Lethe maitrya maitrya** DeN.

Talbot F.B.I. 276a; Evans 3.5.

Several specimens brought in by collectors from North Central Nepal in August 1937. Never taken in the Valley.

87. **Lethe jalaurida jalaurida** DeN. (W)

Talbot F.B.I. 282a; Evans 3.11.

A single specimen brought in from Jalbiri, North Central Nepal, 3-8-37.

88. **Lethe goalpara goalpara** M. (E)

Talbot F.B.I. 285a; Evans 3.14.

A single specimen brought in from Barabar, North Nepal, 20-8-35.

89. **Lethe baladeva** M. (W)

Talbot F.B.I. 288; Evans 3.17.

Four specimens only: Godavari, 5,000 ft., 10-5-37., Chitlang south of the Valley, 5,000 ft. 23-4-38. Two brought in from North Nepal by collectors, Dejen Gompa, 7-6-37, Patichaur, 14-5-37. I cannot distinguish the race *aisa* Fruh. from *baladeva* M. There is only one specimen of each sex of *aisa* in the British Museum.

90. **Lethe rohria rohria** Fd. (W)

Talbot F.B.I. 293a; Evans 3.22.

Three specimens from the Valley 1-11-36, 30-10-37 and 24-3-39, and one from Thankot above the Valley, 6,000 ft. 17-7-37.

91. **Lethe confusa confusa** Aur.

Talbot F.B.I. 296; Evans 3.25.

Very common in the Valley. The spring brood are on the average smaller than those appearing later.

92. **Lethe insana dinarbas** Hew.

Talbot F.B.I. 306b; Evans 3.34.

A few at Godavari in the Valley in May. Also on the surrounding hills up to 6,000 ft. April to November. A few brought in from the north by collectors in May. Always in thick forest.

93. **Lethe kansa** M.

Talbot F.B.I. 311; Evans 3.38.

A few in the Valley in April and May and again in October. A few at Nagarkot 7,000 ft. between July and November.

94. **Lethe verma sintica** Fruh. (W)

Talbot F.B.I. 317b; Evans 3.44.

Common in the Valley and on the surrounding hills between May and October.

95. **Lethe pulaha pulaha** M.

Talbot F.B.I. 318a; Evans 3.45.

A few brought from North Nepal in May and June. Barku 18-5-35; Sandi, 2-6-35; Kuti on the Tibetan border, 6-6-37; Dejen Gompa 7-6-37.

96. **Lethe yama yama** M.

Talbot F.B.I. 323a; Evans 3.50.

In the thick forest on the hills surrounding the Valley between 5,500 ft. and 7,000 ft. in May and June only.

97. **Pararge menava menava** M. (E)

Talbot F.B.I. 324a; Evans 4.1.

A single specimen from Nepko, West Nepal 11-6-36.

98. **Pararge schakra schakra** Koll. (E)

Talbot F.B.I. 325a; Evans 4.2.

Several brought in from West Nepal in June and July. Kalas, 17-6-36, Barai 19-6-36 and 3-7-36.

99. **Rhaphicera satricus satricus** Db. (W)

Talbot F.B.I. 330; Evans 4.7.

A single specimen taken at Kakni 7,500 ft. 15-9-37. Also two seen at the same place 14-8-35.

100. **Orinoma damaris** Gray.

Talbot F.B.I. 332; Evans 5.

Common in the Valley often at damp soil in May and June. A second brood in September and October.

101. **Aulocera brahminus brahminus** Blanch. (E)

Talbot F.B.I. 355a; Evans 11.1.

A single specimen brought in from Tangar, West Nepal, 7-8-36. Another specimen from Limotang, West Nepal, 16-7-36, appears to be race *brahminoides* M. This is an extension westwards.

102. **Aulocera padma padma** Koll.

Talbot F.B.I. 356a; Evans 11.2.

Many brought in by collectors from North Nepal, July, August and September.

Two specimens appeared to be *A. p. chumbica*: Jalbiri 3-8-37, Sanu Nyesum 20-7-37. If my identification is right this is an extension of habitat westwards.

Two specimens brought from Rasuagarhi 20-8-35, and Langdeng 30-8-35, are nearest to *A. p. loha* Doh.

103. **Aulocera swaha swaha** Koll.

Talbot F.B.I. 357a; Evans 11.3.

Many brought in from North Nepal and from the Tibetan border in July, August and September.

104. **Aulocera saraswati** Koll.

Talbot F.B.I. 358; Evans 11.4.

One from the Valley, 4,500 ft. 29-10-37; several from the surrounding hills in August, September and October. Others brought in from the north.

105. **Erebia nirmala nirmala** M. (E)

Talbot F.B.I. 363a; Evans 13.4.

A few brought in from West Nepal in June 1936.

106. **Erebia scanda opima** Watkins. (W)

Talbot F.B.I. 364b; Evans 13.5.

Swarms in August and into early September at Kakni and Nagarkot above the Valley between 6,000 ft. and 7,000 ft.

107. **Erebia hybrida** But. (E)

Talbot F.B.I. 365; Evans 13.6.

Very plentiful at water above Balaji in the Valley in April and again in August. A great many at Kakni, 7,000 ft, mid-August.

108. **Erebia annada caeca** Watkins.

Talbot F.B.I. 367b; Evans 13.7.

Very common in the woods surrounding the Valley in May and again in September.

E. annada annada M. also occurs at the same time and localities. If this identification is correct this is an extension of habitat westwards.

109. **Erebia hyagriva** M. (E)

Talbot F.B.I. 368; Evans 13.8.

A few in August and many in September and October, both in the Valley and on the surrounding hills.

110. **Ypthima nareda newara** M. (E)

Talbot F.B.I. 373b; Evans 14.4.

Common in the Valley and on the surrounding hills May to September. One emerged on 25th August at Nagarkot 6,500 ft.

111. **Ypthima ceylonica kasmira** M. (E)

Talbot F.B.I. 380c; Evans 14.11.

None in the Valley but some at lower elevations. Common in the Terai in winter.

112. **Ypthima baldus baldus** F.

Talbot F.B.I. 385a; Evans 14.15.

Very common in the Valley and also found in the surrounding hills up to 7,000 ft. Common in the Terai. A very dry form is found in the Valley in March. Pairs were taken *in copula* at Katmandu 20-9-35 and 16-8-37. Also at Devighat 1,500 ft. 25-10-35 and 31-10-35.

113. **Ypthima sakra nikaea** M. (E)

Talbot F.B.I. 390b; Evans 14.21.

Common in the Valley from April to October and also up to 7,000 ft. on the surrounding hills. A pair taken *in copula* at Katmandu 5-9-37 and another at Nagarkot, 7,000 ft. 22-7-37.

114. **Orsotrioena medus medus** Fab.

Talbot F.B.I. 393a; Evans 16.

Common below 5,000 ft. from August to April in all the parts of Nepal in which collections were made. W.S.F. were obtained in August and September, otherwise most specimens were D.S.F.

A single W.S.F. was taken at Tribeni in the Terai in December. A pair *in copula* at Devighat 30-10-35.

115. **Melanitis leda ismene** Cramer.

Talbot F.B.I. 405; Evans 22.1.

Common in the Valley and especially so in the Terai. W.S.F. were taken in August and September only. This crepuscular butterfly sometimes comes to light like a moth.

116. **Melanitis phedima bela** M. (W)

Talbot F.B.I. 406e; Evans 22.2.

Two specimens, one at Katmandu 4,500 ft. 9-10-36, and another at Godavari 5,000 ft. 20-10-36.

117. **Elymnias hypermnestra undularis** Drury.

Talbot F.B.I. 411c; Evans 25.1.

At various places below the Valley in October and November at altitudes between 1,000 ft. and 2,000 ft. Very common at Devighat.

118. **Elymnias malelas malelas** Hew. (W)

Talbot F.B.I. 418a; Evans 25.8.

A few in October both in the Valley and at lower elevations. One brought in from Central Nepal, Chauntara, 13-9-37. A pair *in copula* at Katmandu 2-10-37.

119. **Elymnias vasudeva vasudeva** M. (W)

Talbot F.B.I. 422a; Evans 25.12.

A single specimen brought in by collectors from Trisuli, 25-7-35.

AMATHUSIIDAE

120. **Discophora sondaica zal** Wstw. (W)

Talbot F.B.I. 443b; Evans 10.1.

A single male specimen was taken below Nayakot at 3,000 ft. 2-4-35. It was sucking moisture on the road. This is an extension of the Amathusiidae westwards in the Himalayas. The family occurs in South India.

NYMPHALIDAE

121. **Charaxes polyxena hierax** Fd. (W)

Evans 1.2.

A single ♂ specimen at Amlekganj 1,000 ft. 2-11.36.

122. **Eriboea athamas athamas** Dr.

Evans 2.2.

A few in the Valley in September and October.

123. **Eriboea dolon centralis** Roth. (W)

Evans 2.7.

Valley, April and May.

124. **Eriboea eudamippus eudamippus** Db.

Evans 2.10.

Three specimens in the Valley 4,500 ft. 10-6-34; 5,000 ft. 23-5-36; 5,000 ft. 3-10-37.

125. **Dilipa morgiana** Wd.

Evans 5.

A few in the Valley, mostly at water, May, June and July. One from Laptang near the Tibetan frontier 22-6-37.

126. **Sephisa chandra** M. (W)

Evans 9.2.

Males are common on the hills surrounding the Valley where they fly round treetops. A few in May and July and many in September and October. One female of the *albina* form on 20-10-36.

127. **Euripus consimilis** Wd.

Evans 10.1.

A single male specimen feeding on a peach in the Legation garden at Katmandu on 27-6-37.

128. **Diagora persimilis persimilis** Wd. (W)

Evans 11.1.

Four males in the Valley, April, May, July and September; some at water.

129. **Diagora nicévillei** M. (E).

Evans 11.2.

Several males in May at Godavari. See *Journal of the Bombay Natural History Society*, Vol. 42, p. 819 and Vol. 43, p. 537. This butterfly is named from a single specimen obtained by De Niceville in 1879. No further specimens were obtained until I found it not uncommon in the woods at the fringe of the Valley.

130. **Hestina nama** Db.

Evans 12.

Common in the Valley between May and November. Males fly in the morning round isolated hilltops on the ranges surrounding the Valley.

131. **Dichorragia nesimachus** Bdv.

Evans 16.

Only two specimens taken in the Valley, 23-6-37.

132. **Stibochioma nicea nicea** Gray.

Evans 17.

Common in the woods in and around the Valley, April to October.

133. **Euthalia lepidea lepidea** But.

Evans 18.3.

Plentiful at Devighat (1,500 ft.) in November and December and at lower levels outside the Valley. A single specimen was taken at Godavari in the Valley on 17-4-38. It was also found in the Terai in winter.

134. **Euthalia julii appiades** Men.

Evans 18.6.

Devighat 2,000 ft., 31-10-35. A few brought in by collectors from lower levels outside the Valley.

135. **Euthalia kesava arhat** Fruh. (W)

Evans 18.8.

A single female specimen at Bhimpedi, 1,000 ft. early October 1936.

136. **Euthalia telchinia** Men. (W)

Evans 18.10.

Three specimens in the Valley 5-6-35, and 6-6-36, and a female on 3-10-36.

137. **Euthalia garuda suddhodana** Fruh.

Evans 18.14.

One female in the Valley, 30-10-36. Several of both sexes at Devighat, 2,000 ft. 31-10-35.

138. **Euthalia nara nara** M. (W)

Evans 18.21.

Plentiful on the hills surrounding the Valley up to 7,000′, May to August, and a few in the Valley itself.

139. **Euthalia sahadeva sahadeva** M. (W)

Evans 18.23.

As the last. In the Valley and on the surrounding hills up to 7,000 ft.

140. **Euthalia patala patala** Koll.

Evans 18.26.

Common in thick forests in the Valley only in May and June.

141. **Abrota ganga** M.

Evans 23.

A few in the Valley, June and July.

142. **Limenitis danava** M.

Evans 24.2.

Males common in the Valley, April and May. A few in October which are rather larger and darker than the spring brood. A few females were seen in August and October.

143. **Limenitis dudu** Wd. (W)

Evans 24.5.

A few in the Valley, April and May. A single specimen in August and another in October.

144. **Limenitis procris procris** Cr.

Evans 24.7.

A few in the Terai in winter and one at Devighat 2,000 ft. 25-10-35. Not seen in the Valley.

145. **Limenitis trivena pallida** Tyt.

Evans 24.8.

A few brought by collectors from West Nepal in June 1936.

146. **Pantoporia nefte inara** Db. (W)

Evans 25.2.

One in the Valley and several in the Terai and at Devighat in winter.

147. **Pantoporia cama** M.

Evans 25.3.

In the Valley, April to October. At Nagarkot 7,000 ft. July to September. One at Devighat 1,500 ft. 25-12-34.

148. **Pantoporia selenophora selenophora** Koll.

Evans 25.4.

A few in the Valley, March to August and again in October. One at Devighat 1,500 ft. 3-11-36.

149. **Pantoporia opalina opalina** Koll.

Evans 25.8.

Very common in the Valley and on the surrounding hills between April and October. A larva found on *Berberis asiatica* Roxb. (Berberidaceae). Pupated on the 10th of August and emerged on the 27th of the same month.

150. **Pantoporia perius** L.

Evans 25.14.

Plentiful in the Valley and on the surrounding hills where it flies round isolated hilltops along with males of *Hestina nama*, *Sephisa chandra* and *Teinopalpus.* Also common at lower elevations at Devighat and in the Terai in winter.

151. **Pantoporia jina jina** M.

Evans 25.15.

Three specimens in the hills above the Valley: Nagarkot 6,000 ft. 4-7-35; Godavari 6,000 ft. 28-7-37; 5,000 ft. 19-5-38.

152. **Neptis columella ophiana** M.

Evans 26.1.

Only at low elevations outside the Valley. Bhimpedi 2,000 ft. October '36. East Terai 2-3-36.

153. **Neptis mahendra** M. (E)

Evans 26.5.

Two specimens from West Nepal in June.

154. **Neptis hylas varmona** M.

Evans 26.6.

The low elevation form *varmona* is common in the Terai and at Devighat below the Valley. A few of this form were taken along with the *astola* form, which is more plentiful in the Valley and which is also found on the surrounding hills from March to November. Specimens taken in June and July are very dark on the underside.

155. **Neptis nandina susruta** M.

Evans 26.8.

A few in the Valley in spring. Nagarkot 5,000 ft. 10-4-35. Katmandu 11-5-35. Godavari 5,000 ft. 19-5-36.

156. **Neptis yerburyi** But.

Evans 26.9.

Common in the Valley and a few on the surrounding hills, March to October; a few in the Terai in winter.

Pairs were caught *in copula* on 24-8-35 and 16-4-36. Both *yerburyi yerburyi* But. and *yerburyi sikkima* Ev. were obtained. Specimens of *y. yerburyi* were taken in the spring and *y. sikkima* in the autumn.

157. **Neptis sankara** Koll.

Evans 26.10.

Three specimens at Godavari in the Valley. That taken on 9-5-37 is *sankara sankara*; the other two on 20-5-34 and 14-8-37 are *sankara quilta* Swin.

158. **Neptis cartica cartica** M. (W)

Evans 26.13.

Not uncommon in the Valley. A brood appeared in May and another in August.

159. **Neptis ananta ochracea** Evans.

Evans 26.15.

Common in the Valley in May. Two specimens at Nagarkot 7,000 ft. 8-9-35 and 5,000 ft. 10-9-35.

160. **Neptis miah miah** M. (W)

Evans 26.16.

One specimen at Bhimpedi below the Valley 2,000 ft. early October 1936, and one specimen at Katmandu, 4,500 ft. 13-5-35.

161. **Neptis antilope melba** Ev. (W)

Evans 26.18.

Four specimens at Godavari in May 1937.

162. **Neptis manasa** M. (W)

Evans 26.21.

A few were taken at Godavari 5,000 ft. in May 1937, but at no other time or place.

163. **Neptis nycteus nycteus** DeN. (W)

Evans 26.22.

Two specimens at Godavari 5,000 ft. 15-5-37. 19-5-38.

164. **Neptis narayana nana** DeN. (W)

Evans 26.23.

Not uncommon in the Valley but only taken in May.

165. **Neptis hordonia hordonia** Stol.

Evans 26.32.

Common at Devighat and other places below the Valley.

166. **Cyrestis thyodamas thyodamas** Boisduval.

Evans 27.4.

Common in the Valley; often at water and damp soil. One specimen at Devighat, 1,500 ft. 31-3-35; several at Nagarkot 6,500 ft. in September. The specimens vary between the forms *ganescha* Koll. and *thyodamas* Bdv.

167. **Chersonesia risa** Db. & Hew.

Evans 28.1.

A single specimen at Nowakot north of the Valley, 3,000 ft. 17-10-35.

168. **Pseudergolis wedah** Koll.

Evans 29.

Not uncommon at Godavari in the Valley in October.

169. **Hypolimnas misippus** L.

Evans 30.1.

Several males in the Valley in September and October.

170. **Hypolimnas bolina** L.

Evans 30.2.

None in the Valley but a few at Nagarkot between 6,000 ft., and 7,000 ft. in September; also several in the Terai in winter. A pair were taken *in copula* at Nagarkot 6,000 ft. 31-7-37.

171. **Kallima inachus inachus** Bdv.

Evans 34.2.

Many in the Valley, March to October. More plentiful in the spring. At lower elevations in October.

172. **Precis hierta hierta** F.

Evans 35.1.

Not uncommon in the Valley from March to May; a second brood appears from August to October. Common at Nagarkot up to 7,000 ft. Pairs were taken *in copula* in July.

173. **Precis orithya swinhoei** But.

Evans 35.2.

Very common in the Valley, March to August. Also common on the surrounding hills up to 7,000 ft. between July and the 8th of November. Also common in the Terai. The Terai winter form is paler than the specimens taken in the Valley in summer. Several were taken *in copula* at Nagarkot in July.

174. **Precis lemonias persicaria** Fruh.

Evans 35.3.

Common in the Valley. D. S. F. from January to April; W.S.F. in August. D. S. F. in the Terai in December and January.

175. **Precis almana almana** L.

Evans 35.4.

In the Valley D. S. F. were found from September to November and W.S.F. June to August. In the Terai and at lower elevations the D.S.F. was common October to February.

176. **Precis atlites** L.

Evans 355.

A single specimen at Balaji in the Valley 4,500 ft. 2-9-37. Many in damp scrub at Devighat 1,500 ft. at the end of October.

177. **Precis iphita siccata** Stich.

Evans 35.6.

Common in the Valley all the year except November to February. Females were seen ovipositing at Balaji in the Valley 29-7-35, and at Nagarkot 6,000 ft. 2-9-35.

178. **Vanessa cardui** L.

Evans 36.1.

Common in the Valley and up to 7,000 ft. at Nagarkot in the surrounding hills. It is found all the year round except from November to February. In the Terai in winter.

179. **Vanessa indica indica** Herbst.

Evans 36.3.

Very common in the Valley. A spring brood appeared in March and April and an autumn in July and August. Again very many appear in October and November after which they are not seen till March. Many larvae and pupae were found in colonies on nettles. One emergence in July and many in October and November.

180. **Vanessa canace canace** L.

Evans 36.4.

Common in all localities, in the Valley, on the surrounding hills, and at lower elevations outside. Not seen during December, January and February. A larva was found on *Smilax macrophylla* (Liliaceae) pupated on 22-8-35. and emerged on 2-9-35. Most are sub-species *canace* L. but some approach *himalaya* Evans.

181. **Vanessa cashmirensis aesis** Fruh.

Evans 36.10.

Very common everywhere except during December, January and February. Many emerged at the end of October.

182. **Vanessa xanthomelas fervescens** Stich. (E)

Evans 36. 11.

One in the Valley 5,000 ft. 9-3-36. One at Nagarkot 7,000 ft. 8-5-37, and one brought in from Patichaur in north Nepal 11-11-37.

183. **Symbrenthia hippoclus khasiana** M.

Evans 38.1.

Appears in considerable numbers in the Valley in March.

184. **Symbrenthia hypselis cotanda** M.

Evans 38.3.

A few in the Valley in March and April. A fresh brood appears in September and October. It is found both in the Valley and in the hills up to 7,000 ft.

185. **Argynnis hyperbius hyperbius** L.

Evans 39.1.

Common in the Valley and the surrounding hills; more plentiful from June to September. Pair *in copula* 12-9-37.

Emergences on 3-10-35, 1-11-35 and 9-10-36.

186. **Argynnis childreni childreni** Gray.

Evans 39.2.

Not uncommon in the Valley and on the surrounding hills up to 7,000 ft., from May to July; a few in October. It was not seen in the Terai or at lower elevations. Several were brought in from North Nepal by collectors.

187. **Argynnis kamala** M. (E)

Evans 39.3.

A few brought from western Nepal June, July and August.

188. **Argynnis lathonia issoea** Db.

Evans 39.8.

In the Valley and the surrounding hills from March to June. A great many brought in from western and northern Nepal in May and June. A pair *in copula* 15-5-37.

189. **Melitaea arcesia irma** Higgins. (*Transactions R. Ent. Soc.* Vol. 9. Part 7. 1941.)

Evans 40.7.

Many brought in from West Nepal in July and August 1936.

190. **Cupha erymanthus lotis** Sulz.

Evans 41.

A few in the Valley and surrounding hills from May to August; a single specimen in October.

191. **Atella phalanta** Drury.

Evans 42.1.

A few in the Valley, and the surrounding hills from May to October. An egg deposited on 15-8-35, hatched on 21-8-35 and the imago emerged on 11-9-35.

192. **Issoria sinha sinha** Koll.

Evans 43.

A few in the Valley, June to October. One taken in the Terai on 16-1-36 is form *pallida* Evans.

193. **Cynthia erota erota F.** (W)

Evans 44.

A single worn specimen at Nagarkot 6,000 ft. 3-7-37.

194. **Cethosia biblis tisamena** Fruh. (W)

Evans 47.1.

Common in the Valley, March to April. A second brood appearing from August to October. Many larvae on Passion Flower (Passifloraceae) in the Legation garden pupated in December 1936; of these two emerged on 7-3-37 and five on 11-3-37. Eggs on Passion Flower hatched on 17-8-37. Seven of these pupated on 6-9-37, and others a few days later. These emerged as perfect insects on 16th, 17th and 18th of September the same year.

195. **Ergolis ariadne pallidior** Fruh.

Evans 49.1.

A single specimen from the western Terai on 2-1-37.

196. **Ergolis merione assama** Ev. (E)

Evans 49.2.

Not uncommon in the Valley but only found in September and October. A single specimen at Devighat 1,500 ft. 25-11-34.

ACRAEIDAE

197. **Acraea issoria issoria** Hub.

Talbot F.B.I. 450a; Evans 51.

Kakni, above the Valley, 7,000 ft., June to September. In September the butterflies were seen emerging in great numbers.

The separation into sub-species by size does not seem to be justified. According to Talbot in F.B.I. *A.i. issoria* Hub. (50 to 70 mm.) is from the eastern Himalayas while *A.i. anomala* Koll. (45 to 65 mm.) is from the western Himalayas. The largest specimens I have are from the Simla Hills ; a male is 70 mm. and a female 80 mm.

(*To be continued*)

TWO NEW SPECIES OF PIMPINELLA

BY

M. L. Banerji

(*Botany Department, Meerut College*)

The author, while identifying the Umbelifers of his collection of Nepal plants, came across two hitherto undescribed species of *Pimpinella* in the Herbarium, Indian Botanic Garden, Calcutta.

These species have not been listed by Wolff in his monograph of the genus in Engler, Pflanzenr. IV, 288 (1927). They are not given in the subsequent supplements of the *Index Kewensis* either.

Pimpinella clarkeana Watt ex Banerji, spec. nov.

Herba erecta, parva, tenuis, 15-30 cm. alta, caulibus teretibus, striatis, non ramosis, cavis. *Folia* radicalia atque caulina, membranacea, glabra. Folia radicalia longe petiolata, patentia, 3-foliolata; petiolus tenuis, complanatus, 5-15 cm. longus, ad basim alatus alis squamae similibus; foliola 1.5-4.5 × 1-3.5 cm., ovata, simplicia vel praesertim foliolum terminale 2-3-lobata vel 2-3-fida (folioli bilobati segmenta varia, inaequalia), cuneata vel rotundata ad basim, foliolum terminale regulare, caetera inaequalia, ad margines alte serrata, acuta ad apices; petioluli 2.5-7.5 mm. longi. Folia caulina multo minora, 3-fida vel 3-lobata, petiolis 1-2 cm. longis.

Inflorescentia terminalis, ad 4 cm. diam.; radii primarii inaequales longitudine, 12-17 numero, ut plurimum erecti; bracteae nullae. Radii secundarii tenues, inaequales longitudine, 0.5-2 cm. longi, 3-5-flori; bracteolae 1-3, lanceolatae; pediculis circa 4 mm. longis. Flores albi, hermaphroditi. Calycis segmenta lanceolata; petala glabra, obovata, emarginata. Fructus oblongus, circa 4 mm. longus, tenuiter assymmetricus; sulci 2-3-vittati; carpophorio bifido.

Typus, G. Watt 6556, lectus in loco Chingsow, Manipur (Assam), altit. 8000 ped., die 18 mensis aprilis, 1882, invenitur in Herb. Calcut.; *paratypus,* Banerji 446, lectus in loco 'Arun Watershed' (Nepalia), altit. circa 10,000 ped., die 21 mensis maii 1948, invenitur in Herb. Calcut., et Blatter Herb., St. Xavier's College, Bombay, et Herb. Meerut College, Meerut.

Pimpinella clarkeana Watt ex Banerji, spec. nov.

A slender, small, erect herb, 15-30 cm. high, with rounded and striate, unbranched, hollow stems. *Leaves* radical and cauline, membranous, glabrous. Radical leaves long-petioled, spreading, 3-foliate; petioles slender, flattened, 5-15 cm. long, base often with scale-like wings; leaflets 1.5-4.5 × 1-3.5 cm., ovate, simple or, especially the terminal one, 2-3-lobed or-fid (in 2-lobed leaflets the lobes various, unequal); base of leaflets cuneate or rounded, in the terminal one regular, in the lateral leaflets often unequal-sided; margins deeply

serrate, tips acute; petiolules 2.5-7.5 mm. long. Cauline leaves much smaller, 3-fid or -lobed, petioles 1-2 cm. long.

Inflorescence terminal, up to 4 cm. diam., primary rays unequal in length, 12-17 in number, mostly erect; bracts none. Secondary rays slender, unequal in length, 0.5-2 cm. long, 3-5-flowered; bracteoles 1-3, lanceolate; pedicels about 4 mm. long; flowers white; hermaphrodite. Segments of the clayx limb lanceolate; petals glabrous, obovate, emarginate. Fruit oblong, about 4 mm. long, slightly asymmetrical; furrows 2-3-vittate; carpophore bifid.

The *type,* G. Watt 6556, was collected at Chingsow, Manipur (Assam), at an altitude of 8,000 ft., on 18 April 1882; the *paratype*, Banerji 446, was collected at the Arun Watershed (Nepal), at about 10,000 ft. altitude on May 21st, 1948.

Pimpinella urceolata Watt ex Banerji, spec. nov.

Herba robusta, alta, erecta, 30-50 cm. alta, caulibus teretibus, striatis, ramosis, cavis. *Folia* membranacea, glabra, ut plurimum caulina; radicalia folia raro adsunt; cum vero adsunt, sunt indivisa. Folia caulina 3-foliolata, petiolis complanatis atque tenuiter striatis, 4-8 (generatim 8) cm. longis, pilosis. Foliola tenuiter pilosa, ovata, 1.5-4 × 2-4.5 cm.; foliolum terminale in inferioribus foliis tripartitum, in superioribus vero indivisum, omnia glabra vel glabrescentia supra, pilosa infra praesertim ad nervos; ad margines serrata, ad basim ut plurimum cordata, aliquando tamen rotundata vel cuneata, ad apices acuta vel acuminata; petioluli 5-15 mm. longi, raro longiores, tenuiter pilosi.

Inflorescentia terminalis vel axillaris vel folio opposita; radii primarii 9-12, longitudine inaequales, circa 15 mm. longi, patentes; bracteae nullae. Radii secundarii 6-9 (ut plurimum 8); bracteolae 3-5, filiformes, 2-4 mm. longae, tomentosae. Flores albi, minuti, hermaphroditi; pediculis 5 mm. longis, nonnumquam tamen brevioribus. Calycis limbus squamae similis; petala glabra medio nervo prominenti ornata, tenuiter mucronata; stamina petalis aequalia. Fructus 2, raro 2.5 mm. longus, lateraliter compressus, initio pilosus, tandem pubescens, oblongus; sulci tenues; stylopodium capitatum.

Typus, Anderson 623, lectus in Sikkim, in loco Tonglo, altit. 3,500 ped. die 2 octobris 1862, invenitur in Herb. Calcut.; *paratypi* (*a*) duo specimina in Herb. Calcut. ex loco Tonglo absque nomine auctoris, lecta die 1 octobris 1857; (*b*) Kurz, tria specimina in Herb. Calcut. absque numero, lecta die 14 octobris 1868 and die 21 octobris 1868, ex loco Tonglo? ; (*c*) Gamble, ex loco Tonglo, 9,000 ped. altit., lectus mense julio 1882.

Pimpinella urceolatā Watt ex Banerji, spec. nov.

Tall, robust, erect herb, 30-50 cm. high, with rounded striate, branched, hollow stems. *Leaves* membranous, glabrous, mostly cauline, the radical ones seldom present and then undivided. Cauline leaves 3-foliate, petioles flattened and slightly striate, 4-8 (generally 8) cm. long, hairy. Leaflets slightly hairy, ovate, 1.5-4 × 2-4.5 cm., the terminal leaflets in the lower leaves 3-partite, in the upper ones undivided, glabrous or nearly so above, hairy beneath especially along the nerves; margins serrate, base mostly cordate, occasionally rounded to cuneate, tip acute or acuminate; petiolules 5-15 mm long, rarely longer, slightly hairy.

Inflorescence terminal, axillary or leaf-opposed; primary rays 9-12, unequal in length, about 15 mm. long, spreading; bracts none. Secondary rays 6-9 (mostly 8); bracteoles 3-5, filiform, 2-4 mm. long, tomentose. Flowers white, minute, hermaphrodite; pedicels 5 mm. long, occasionally shorter. Calyx limb scale-like; petals glabrous with a somewhat prominent midrib, slightly mucronate; stamens equalling the petals. Fruit 2, rarely 2.5 mm. long, laterally compressed, at the beginning pilose, at length pubescent, oblong; ridges faint; stylopod capitate.

Type, Anderson 623, from Tonglo in Sikkim, collected at 3,500 ft. altit., on Oct. 2, 1862; *paratypes* (*a*) two sheets in Herb. Calcut. from Tonglo, without collector's name, gathered on Oct. 1, 1857; (*b*) Kurz, three sheets in Herb. Calcut. without number, collected on Oct. 14, 1868 and Oct. 21, 1868, at Tonglo? (*c*) Gamble, Tonglo, 9,000 ft. altit. July 1882.

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FORTY YEARS OF SPORT ON LITTLE KNOWN ASSAM RIVERS

BY

W. E. D. COOPER

PART I

(*With two plates*)

My first Christmas day in India in 1900 was spent in a houseboat on the lower reaches of the Barak River which fired me with a desire to see what lay above, an urge I never lost and was nearly able to complete as far as these rivers were navigable, 30 odd years later. The Barak flows from the state of Manipur into the plains of Cachar and eventually into the delta of the Brahmaputra. It is fed by four main hill rivers above where it enters the plains of Cachar which were all the home of the noble Mahseer. Of these the Tepi', coming from the Lushai hills, was my first and last love, but I had also excellent sport on the Jheeri and later on, when I was able to get there, on the Macrup and Irung by hauling boats through the Big Gorge and over the Elephant Rocks, which, in my earlier days, were considered impassable. Three years later a friend and I, on a fortnight's leave, managed with a crew of six, a cook and a bearer to drag a houseboat up the rapids to within half a day of the mouth of the Tepi', which we reached in a dugout in seven or eight days, a trip we did in three days with the aid of a motor boat up to the first rapid, in later years. The country then was quite unspoilt, and with the exception of a wandering Lushai or Kooki, one saw no human beings.

We had no fishing tackle with us and I well remember seeing shoals of fish leaving the shallows. Shooting, however, was good and we had no difficulty in keeping the camp supplied with meat. This consisted chiefly of sambar and barking deer, with plenty of junglefowl, pheasants and pigeons of various sorts, with occasional duck and teal. What we could not eat was dried over camp fires on a bamboo frame and taken home for consumption by the crew. Turtle eggs were plentiful and excellent eating.

Camping on a sandbank was fairly primitive and I remember a tiger walking down to drink one night between a Boy Scout tent which we were sleeping in, and the cook under a tarpaulin a few yards away. As after this I always kept a big log fire going all night it never happened again.

Two years later I managed to acquire some fishing tackle, and with another friend, set off in two small and two large dugouts with a crew of twelve and reached the first rapid at Minadhur in two days, here the fishing water began. Our tackle consisted of bamboo trolling rods and a fly rod each, some No. 7 and 8 spoons and fly spoons. The first mahseer I caught was 27 lb. It took my 150 yards of line out to the wood of my reel, but having 'Griffin's luck', stopped at that moment and with the aid of my boatmen, I managed to land him by beaching on a spit of sand. I know nothing that gave me such a thrill as the first rush of that mahseer!

We explored the Tepi' and caught fish, also got as far as the Big Gorge on the Barak, a rather awe-inspiring length of the river, which here narrows down from one to two hundred yards width to twenty or thirty, rushing down between huge blocks of rock which have come down from the overhanging cliffs, through which I did not take the boats till 25 years later. I see from an old record that I landed 90 lb. of mahseer and we shot 14 pheasants, 39 junglefowl and 2 deer, which does not in anyway represent the fish hooked or ammunition expended. I was also up the Barak in 1906 when I landed 108 lb. of fish and shot an 18 ft. Gharial (Long-nosed Crocodile) up the Tepi'. In these early days one saw a dozen or more basking on sandbanks, but this was the first time I had an H. V. rifle capable of severing the spinal chord at the neck, the one shot that will prevent them slipping back into the water. I remember trying to gaff one whose back had been broken from a dugout which would have caused a disaster if I had not let it take my gaff.

In 1908 I went up with my brother for three weeks at Christmas and discovered that mahseer go clean off in very cold weather, the fishing was poor, so all subsequent trips were made in November as soon as these rivers had cleared sufficiently to fish.

I left this district in 1908 and it was not till 1916 that I was able to fish again, this time with an experienced fisherman who taught me how to use a fly on the smaller rivers. I also started to write up a log over the camp fire every night from which I shall quote in the rest of this story.

The Jheeri, a pleasant little hill river without the magnificent scenery of the Barak, we could reach by a track, on horseback, riding out some 25 miles to a spot where we had sent our boats three days before. These were newly built boats with flat bottoms, much more comfortable than dugouts to fish from. In later years I built my own at a cost of Rs. 1/6 per ft., supplying planks and fittings myself.

The flies we used were large salmon flies which we called Yellow Spider and Claret & Mallard, a 10 ft. split cane and a short American spinning rod were my first tools. I also used a fly spoon a lot which, was especially effective when water was at all discoloured. In a week's fishing my mentor landed 77 fish and I 55, the best fish weighing 7 lb. I lost a good few, especially on the short spinning rod.

In 1917 the Jheeri again with the same companion. We had by this time formed an Angling Association which hired the fishing rights on this river from Government, and kept two watchers to prevent netting when the rivers were low. On this trip, using similar methods we landed 140 fish between us, the best 10 lb. I have never known a mahseer over 10 lb. to take a fly ; anything bigger was caught spinning or trolling.

When at the top of the river we heard drums beating all over the hills, and on our arrival back in civilization three days later were told that the hill people were in revolt, had burnt all the rest houses on the track into Manipur and killed the caretakers. They did not interfere with us. This revolt was not squashed for two years, the ringleaders being rounded up on a hill above where we were camped when we heard the drums.

In 1923 and 1924 I fished the Jheeri again with less experienced companions. We caught rather fewer fish than on previous trips, and there was not a great deal to shoot on this river, but we had enough for the pot. Otters were common in packs, and as they spoilt the fishing, were shot. I also remember seeing a pack of red dog in full cry after a sambar, making a noise rather more like a monkey than a hound. When the sambar eventually stands, they jump up and blind it with their teeth, without leaving a mark on its face, and then tear it to pieces. A friend of mine actually watched this taking place.

I see we had some difficulty in getting to our boats, as, after swimming our horse across the Jheeri, found all bridges had been washed away and we had to walk the last five miles. Also that on the last trip I landed a 10 lb. mahseer after falling on my back in the boat and dislodging my reel. The catch was 78 fish, the majority caught on a Claret and Mallard.

Up the Barak again after seventeen years, with two ladies. Our companions on this trip were experienced campers and really knew how to do things in comfort. My boats were sent off two days ahead, and, leaving in a motorboat we were at the first rapid in a morning to find camp all ready for us.

Three days slogging up rapids brought us to the mouth of the Tepi' with little fishing on the way as the river was full up with timber rafts and bamboo cutters; very different from what I remember it.

There was, however, a lovely new sandbank at the mouth of the Tepi' which looked promising and on which we made our permanent camp. Gharial were still fairly plentiful and my companion, who had not fished before, spent most of his time after them whilst I fished the Tepi' where it was thrilling to recognise scenes of early adventure.

The top gorge produced a 24 lb. mahseer which, with my wife and three men in the boat, took some landing as both banks were sheer rock and we had to use the net. Our friends had brought up a bottle of champagne to be opened for the first fish over 20 lb. so we were soon celebrating. What I had learnt on the Jheeri served me in good stead on the Tepi' which I soon discovered was the perfect fly river, and landed 10 good fish on the evening rise. In this type of fishing the boatmen, without taking their paddles out of the water keep one at casting distance from the rocky banks, and by casting from a sitting position low down in the boat many more fish were hooked than when standing up, especially when water was very clear. It did not seem to matter much whether one fished up or down except in fast water, when by fishing up one did not overrun the water.

Paddling down slowly I watched two fishing cats scooping up small fish from an overhanging branch. I shot one with a pretty and rather rare skin. Having warned our companions not to get benighted as there were several bad rapids to be negotiated, I sent them up to troll the top gorges and had some good sport with a fly spoon lower down. My diary for that evening was as follows:

'W, though an experienced camper had not done any fishing, went up the Tepi' with his wife to troll the two top gorges and we followed later. Owing to a landslide water dirty and fish not taking a fly at all. Only one little mahseer in the morning, but had a good evening rise, all good fish which I landed safely, chiefly on a fly spoon after some excitements and got back to camp at dark to find the servants had killed a good barking deer, chased into the rapids by wild dogs. No sign of the W's so sent off a boat with lamp and torch. Began to get alarmed as they did not arrive till 7-30 p.m. having been benighted and upset in a rapid. They had got on to a rock on one side of the river, while their crew, who had gone overboard were washed to the other with the boat, all in the pitch dark. Glad to have everyone back in camp safely. An exciting day all round and an unpleasant experience for the W's who will get back in daylight in future when bad rapids have to be negotiated. W had caught his first fish and stayed too long in the gorge. I had 6 good fish and a pigeon.'

On the way down the Barak, still full of elephants and timber watched a young elephant having a great game with the rafts which it was trying to break up till its mother's mahout intervened.

At the top of one quiet rapid I hooked the biggest mahseer I have landed in these rivers, 37 lb., after a good long fight. A little further down found W with a 17 ft. Gharial he had killed at well over 100 yards and helped him get it down to our camp on the Kommandhur pool where I remember in an earlier trip a friend landed 6 mahseer between 20 and 30 lb. each one afternoon. Dropping down to join our motorboat, stalked and shot a 13 ft. Gharial, just the size my wife requires for a suitcase.

The next two years, seeking new pastures, I sent my boats into the Sonai, a river flowing from Lushai into the Barak lower down. Two young friends had borrowed my boats in January a year before, and had done quite well spinning until chased out by a rogue elephant. On neither trip were we lucky with the water which was too cloudy. Owing to the sandy bottom being full of snags in the shape of trees that had been washed down in the monsoon, we lost two out of three fish hooked on light fly tackle. The following extracts from my diary are typical of our sport in the upper reaches:—

'Left camp 7-30, water high but clearing, got into a fine gorge at 12 and had lunch with B who went down and I up. Nothing but thrills from the time he left. A big one took on my short rod, but hooks came away after he had taken out 30 yards of line, lost another and landed one on the fly rod, then got into another big fish on fly which ran down a rapid taking all my line before I could get the boat round, and broke me. A cheerful afternoon of combined bad luck and bad management in a fine wild country. B had 2 fish and had risen several; also had seen 4 red dogs and shot several pigeons.

Left at 8 a.m. for the gorge country again in shikar boats, not a fish moving in the morning, but shot a sambar where a big fish broke me yesterday. Had lunch with B who started down whilst I picked up the sambar I had cached. Ran a few fish and landed a nice little 5 lb. mahseer on a fly, reached camp at dark and found B with one decent fish and a broken fly rod. Also shot a garganey and pigeons.

Made a late start, *mahl* (baggage) boats left ahead for our second camp. Tried everything in the morning but nothing taking. Put on a Claret and Mallard 3 p.m. and fish came on well. Reached our second camp late with 7 fish, the best 5 lb; B had only one.'

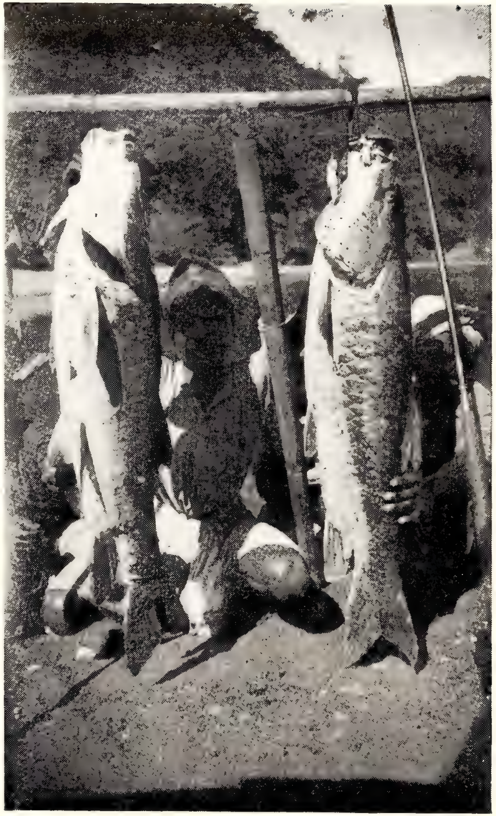
I also shot a Monitor lizard 8 ft. long with an H. V. rifle, far the biggest I have ever seen in these parts.

The Barak again in 1928 with the same party as in '25 and did not reach the mouth of Tepi' till the fourth day owing to heavy water. Camps were all on island sandbanks with a rapid on each side which

Camping in comfort.

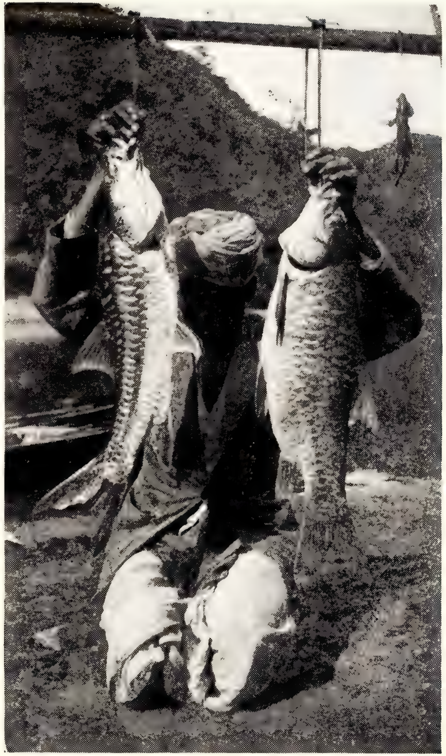
Photos *Author*

The Boro Hattias.



Photos

Two good mahseer from the Barak.



Author

A mahseer and ' pakhi runga '.

made them particularly pleasant. Found the Tepi' more populated with orange groves on the hill-sides, and cow tracks on the river banks where formerly only game tracks were visible, so took a light camp up the Barak to below Big Gorge which we explored with a view of taking boats through one day. Found we had left all drinks behind at the main camp and having no fish or game, had to open tins for dinner, a rare occurrence on these trips.

I returned to the Tepi' early and landed 3 fish up the little river on the evening rise. W came in later with a 29 lb. Mahseer caught on the troll and had lost another owing to line fouling his boat when landing.

The same evening we were joined by another friend who had come up, travelling most of the night before with a full moon. Our new friend M and I went up the Barak next morning, and had one of the best days I remember for big fish. My diary reads as follows:—

'Went up the Barak and passed him landing a 29 lb. mahseer; as I did so I hooked a 14 lb. mahseer and landed it on the same bank, had a great afternoon coming down and a big fight with a 27 lb. fish, foul hooked on dead bait tackle, which we followed for a mile down stream before landing it. Wife thrilled. I landed another 26 lb. fish and came in with 4 fish, 73 lb; M with 5 fish 64 lbs. W had a blank day up the Tepi' where he was trying a fly and a fly spoon.

Left camp next morning and I was lucky going down to Kommandhur, landing a mahseer at nearly every run, six in all including a Black Mahseer, nothing over fifteen pounds, all caught on a Macdonald Spoon. In the run below camp struck a wonderful rise of 'Butchwa', one of our best eating fish, and landed 12, three over 2 lb. Blackamore Fly, before dark. M, who had stayed another day in our Tepi' camp landed a 56 lb mahseer the heaviest I have known taken out of this river on rod and line. A trip which began badly and ended well. One never knows with fish!

I was on leave in 1929 and decided to try the Jheeri again with B. The fly fishing was good as ever and accidents more frequent than usual. We landed 104 fish and my diary records these accidents :—

'Left a not too comfortable camp where my bed broke. B following with camp. Water looked good, but did not move a fish till after 11 a.m. when I did well with a Blackamore for 2 hours. B caught me up after lunch as I was landing a 4 lb. mahseer on my trout rod. He had left the boats just behind. I got to camp site at 4 p.m. but no sign, so went back, and met my boatmen who told me that one of B's boats had upset in a rapid. Went on down and collected it at 5 p.m., all very wet. The most serious losses were rice, lamps, shoes, 100 cartridges and batteries for torch: a chapter of accidents as I also broke a rod and lost a good spinning line. Camp pitched well after dark with a small fire; decide to stay tomorrow in this camp and dry things, sending the river chowkedars, who joined us, back to Jheeri Ghat for more rice. I had 6 useful fish, all on fly; B only one, using a fly spoon.

B went off 8 a.m.; I at 10 a.m. after sorting tackle and a bath. Broke my small rod top in a fish just off camp, not much doing till 12, after which fish were taking well; saw B in the distance and turned. All my fish were Carp, (Bora) caught on a yellow Spider. Boys recovered some of the lost property and a lamp by diving.

I had 11 fish; B had 6, best 3½ lbs.'

B who did not like drinking his evening peg out of my aluminium mugs had carefully brought two glasses in a haversack on his back on a horse. These like other things were lost when his boat upset so had to drink out of my mugs after all ! On my way home my diary records more accidents ' went off 8 a.m., started trolling 11 a.m. and immediately landed a 12 lb mahseer. Had a good day with my fly rod afterwards'. B came on with the camp as there were bad rapids and did not get as far as usual. I got back to camp at dark with 10 fish and found B with three, his best a 4 lb carp.

B left early and I followed in charge of *mahl* boats as they took a lot of time getting up rapids. A day full of incident, lost an artificial shrimp in a big fish (English mountings not good enough for strong mahseer), and also broke my old Gamage Split Cane in a fish far too big for the rod ; it finished by taking my cast. Otherwise had a good day and eventually got camp pitched 4 hours or so below Jenam Mukh. B had a good day too with various breaks and came in with 5 fish, best 4½ lb. I had 12, best 5 lb. mahseer.

A drop of rain at dawn which soon cleared. B up and I down, after saying goodbye to the river chowkedars who came up from Jheeri Ghat in 2 days with a lamp, more rice etc. to replace what we lost. Both had rather a poor day; B struck rafts coming down and I broke another rod top in a fish on my trout rod.

B came in with 5 fish, best 6 lb; I with 7, best 2½ lb.

B went up and I down, *mahl* boats passed me at 12 at a bad rapid where mine shipped some water and damaged cartridges. Fish rising well. I broke my last fly rod so was reduced to fly fishing with a trolling rod, without much success, fish either coming short or getting unhooked. Also was snagged and broken and lost a good bit of spinning line. Both arrived in camp very tired. B had a wonderful day, 13 fish, best 12 lb, and 2 garganey. I had 6 fish, best 3 lb.'

Up the Barak again in 1931. When on leave I had acquired considerably better tackle, a new Silex, Spinning Rod and Fly Rod bought in England. My companion this time was a young friend, who had not fished before and was unlucky to lose most of his best fish. On arriving at the first rapid by motorboat, where camp had been sent, saw mahseer feeding, and, spinning with a No. 7 spoon landed two before dark. Next day I recorded :—

' Fish still feeding in the rapid at daylight and I landed an 11 lb. mahseer whilst E was shaving, but could not get another. Water very strong in the long dismal reach above Minadhur and sun very hot. Reached Kommandhur, met E and decided to camp early as boats were one hour behind. Few fish to be seen in the good runs so spent most of the afternoon in the shade watching for a feeding fish. Cast a No. 8 spoon over the only one I saw and landed an 8 lb Tiger fish.

Left Kommandhur ahead, had 2 shots at Gharial and hit one hard E caught me up for lunch 1.30. Water very strong and big, trolled and spun, but neither of us could move a fish. Camped about a day below Tepi', may just get there tomorrow. We both shot pigeons.

E went on ahead and I followed, water very strong and too much of it for fish. Caught E up at 12.45, just below the gorge below Tepi' Mukh and had lunch. He had seen wild dogs chase otters into the river, also some Gharial. Arrived at Tepi' Mukh 3-30 and found a decent little sandbank just round the corner for camp.

E went up the Barak and I up the Tepi'. Glad to find some fly water and landed 3 decent fish before dark, *mahl* boats arrived late but managed to get camp pitched. Everyone glad to get into camp for a day or two's rest. Found river chowkidars at Tepi' which also was high but fairly clear. E came in with a pheasant and we both had pigeons.

Went up the Tepi'. Water clear but very high. Did not move a fish on either fly or spoon till 4.15 and finished by being snagged by a good one on my fly rod. Found the Tepi' altered considerably. There is now no waterfall but rapids are bad. Found E in camp after a moderate day up the Big River. Weather extraordinarily warm and, what appeared to be lightning in the sky; most unusual at this time of year. E had 4 fish, best 7 lb and I only two.'

The lovely Tepi' being full of bamboo cutters and rafts, after rather poor days at the mouth moved camp up to just below the Big Gorge. Shot a gharial which managed to get into the water and was picked up next day by my companion, the bullet having pierced the throat; the only one I have ever recovered after it had got into deep water. The local hill people paid us a visit and took away all the meat which by them is looked upon as a great delicacy. I do not think it is generally known that crocodiles are eaten. I once tried a gharial's egg 'never again'! A pleasant enough trip but saw less game than in former years and too many humans, including Lushais who spoke English. At our first camp on the way down an elephant marched through the camp in the night which alarmed the crew somewhat, but went off without doing any damage, when I turned on my torch on him. We landed 35 fish only weighing just under 200 lb and shot one deer only.'

'I was unable to get away for a trip before Christmas, so, having a few days leave at the end of the year, sent my boats up the Jheeri and joined them at Jheeri Ghat with a young friend. We had one boat fitted with an outboard engine but, having broken several propeller pins, decided the river was far too shallow and went to Godown Ghat. The Jheeri at this time is too shallow for boats or fish so made a camp where the track to Macrup and Imphal leaves the plain. My friend returned and I was joined by two others and decided to march to Macrup Ghat with a light camp, about 12 miles over a 1,300 ft. hill, and examine the possibilities of hauling boats over this and coming down the Barak of which the Macrup is a tributary. Somewhere about 1905 two men I knew had conceived the idea of making rafts and floating down through the Hattia Gorges. They took provisions for a fortnight and arranged for boats to meet them below the Hattias up which it was considered impossible to take boats. As they had not arrived in three weeks their boatmen ran out of food and returned for more, eventually meeting them at Tepi' a month after they started. Continually making new rafts had taken longer than they expected and they ran completely out of food, living on monkeys, the only thing they could find to shoot in the Gorges. To lighten their raft they had cached fishing rods and anything they could do without in the jungle. Indians will tell you that something awful will happen to anyone eating monkeys and, within two years of this trip one of these men had committed suicide, the other was in a mental home and their head boatmen and shikari had died of cholera! Incidentally he was the man who landed my first big fish for me. Some time later 2 other men I knew had two dugouts dragged up this track by elephants and got through, but I gathered they did not find it a comfortable trip and were too concerned with getting through to fish much.

With this background and boatmen carrying a light camp we got away about 10 a.m. and reached Macrup, where there is a bamboo suspension bridge, before dark. A fascinating spot and an ideal fly river with quantities of fish to be seen from the bridge. Spent one day there, but only caught an odd fish or two as it was impossible to get up or down far without boats and I came to the conclusion that these must be got there by water. Left next morning and returned to our base camp: my friends sitting over a drink after I had turned in, suddenly woke me up and said they were being stalked by two leopards. Armed with torch and rifle I saw four eyes wandering about at the edge of the water and being somewhat sceptical when I got nearer and turned my torch on, discovered they were two very large civet cats eating refuse, so returned to bed rather annoyed at being woken up.'

This trip convinced me of the impracticability of taking boats over the hills and that they must be got there by water.

The dream of many years at last, after much preparation and pleasant anticipation which preceded these trips by W and myself, seven boats were got off on November 3rd after a cock had been sacrificed and water poured into the prows of the boats, a ceremony always insisted on by the boatmen to propitiate the Gods of the Barak. Boats arrived at the Macrup Bridge on the 15th, having got through the gorges without much trouble with the aid of a long rope. My head man did the 30 miles home by 4 p.m. on the 16th and we got off the stores with 40 carriers by midday 19th. We walked and rode 8 miles in the afternoon to a rest house en route where we stayed the night as often before when fishing the Jheeri.

The following extracts from my diary indicate that our efforts to get our boats above the gorge were amply rewarded :—

'After a comfortable night at the rest house, rose at 5 a.m. and had whole party off by 7-30 and across the Jheeri by 8. Arrived at Macrup 2.45 rather weary. We make the distance a good 14 miles and the height of the highest point 1,300 ft. Found the people left in charge of the camp rather at sixes and sevens but soon straightened things out, and, after a cup of tea, took my light fly rod up the river and landed a nice 3 lb. fish for dinner. W staying in camp to superintend camping arrangements at which he is most expert, so found everything shipshape on my return.

Had a good night and sent back our porters, some 30 odd, and got up the Macrup with a light boat and 2 men. W, who prefers big stuff, went down to the mouth to fish the Barak. Left Okai my head shikari and boatmen to divide the stores up so that we could leave what was not required with the river chowkedars and take a light camp when we moved. Had a first class day with my fly rod, 11 good fish weighing 28 lb. and a 10 lb. mahseer spinning, lost one only. Got back 5 p.m. and found W with 3 good fish caught on the troll in a pool at the mouth. He had been broken and lost two more and 50 yards of line. His 3 fish weighed 43 lb. Had a round table conference at night and decided to move only as far as the Macrup mouth next day and not attempt to reach Hattias as long as fish were taking well higher up as I had previously arranged for two young friends to take the boats back through the gorges, fishing on the way.

Made a late start from Macrup Bridge as all stores had to be sorted, and only necessities taken. Two more carriers returned and chowkedars were left in charge of the balance. Water very low in the Macrup, boats had to be dragged down rapids. I arrived at the mouth 12.15; W at 12.30; *mahl* boats not till 4 p.m. Little good fishing water en route. Had lunch and immediately caught a 32 lb. mahseer spinning on my light rod and No. 7 spoon which took some time to land. W went up the Barak and caught two good fish on the troll and another off camp as the boats arrived. Made a late camp at Mukh and everyone rather weary. W's fish weighed 35 lb, 22 lb and 4 lb. Mine 32 lb with 2 smaller caught on fly.

Had a good night in spite of camping late, took some time fixing up heavy tackle and putting W in the way of using a spinning rod, on which he subsequently caught a fish. I landed a small mahseer off camp while trying rods and then went off up the Barak to explore some new country. Got another fish very soon spinning, also a gharial. After that fish went off in the Upper Gorges which much resemble the Hattias on a smaller scale and finish with a waterfall beyond which it is impossible to take boats. W had a fair day downstream, was broken by a big fish, saw nothing to shoot except a deer which escaped wounded. He had 2 fish 12 lb; I had four 17 lb.

Went downstream 8.45 a.m. and never had a dull moment all day, no luck trolling which is not my strong suit and several accidents spinning, losing 2 big fish on light tackle, one of which broke me at the top of a rapid, another slipped the hooks after being played 10 minutes. I lost 3 spoons and landed 6 small fish only. Shooting was more successful, killed a fine stag and the biggest red dog I have ever seen both at about 100 yards, so with a boat loaded to the gunwale returned slowly to camp.

W went upstream and did not get a fish, but, trolling past camp, hooked and landed a 24 lb. mahseer. I had 6 fish 3–4 lb. each. Two Kookis who visited us in the morning and were given tea, returned in the evening with eggs. Gave them 2 fish and the carcase of the wild dog, which stank the whole camp, as they assured me it was far better eating than venison! We sent them across the river in a boat where they squatted on a sandy spit, cooked and ate the dog, also the entrails of the stag, and seemed to enjoy themselves immensely.

Sorted tackle and went upstream rather late after catching a couple of Chilwa for bait. Barak upstream very short as one soon got into the gorges and waterfall. Hooked a good fish trolling on the way up, but it took me straight into a sunken tree and tied up the line where I had to watch it unhook itself in clear water, but managed to rescue my spinner. Could not move anything spinning so returned to camp for lunch and went up the Macrup with my fly rod where I got two decent fish, some pigeons and a monitor lizard. W came in after an excellent day downstream with the best fish so far, a 36 lb mahseer several small ones, 2 caught spinning: seven in all.

Started the day by catching Chilwa for bait and my bearer finished it by catching Butchwa for dinner on a night line. Went downstream and had very few dull moments. Got a couple of fish trolling, trying for a big one which I eventually got into at 11.30, was taken over a rock ledge and broken losing a new trace and spinner. As I was repairing tackle saw a fine sambar stag crossing a rapid below me. Had a shot at 100–150 yds. and missed in front, but got him as he was galloping back to the jungle.

After towing it up the rapid got it into the boat and it took my crew and self all our time to get to camp upstream by 5 p.m. Met W just below camp; he had been exploring the gorges up above and, though he had no luck with fish he had shot two duck and a pheasant. I had 2 fish 5 and 4 lb. We seem to be more successful with gun than rod. No end of food however, camp absolutely stinking with smoked fish and meat which the crew will take home with them. My bearer caught another good Buthcwa at 7-30 p.m. for dinner. We are leaving tomorrow for a stiff pull up the Macrup where the water is low.

Returned to Macrup Bridge as the water in the Macrup was falling rapidly and is much lower than in any normal year and difficult for heavily laden *mahl* boats. Also we had done very well at Macrup Mukh and thought it well to leave well alone and get the meat and fish to the road to be dried, with a day in hand to sort the stores for E and R who are taking the boats home through the Hattias. I started the day well by landing a 12 lb mahseer off camp on a homemade spinning rod. Our Kooki friends turned up and were given the balance of the sambar meat with which they were delighted. I left ahead of the *mahl* boats and collected 4 decent little fish spinning as they were not taking a fly in the morning. Got to Macrup Bridge 3 p.m. closely followed by *mahl* boats and saw camp started. Went up and got 3 fish on a fly after 4 p.m. W went down the Barak hoping to get another big one but had no luck and a hard pull up in the afternoon with no time to fish.

Very comfortable camp, baths, etc. with our own fish and pheasant for dinner. I think someone has been at the brandy bottle!

Weather turned rather cold; water in Macrup very low and mostly gin clear. W went off upstream after I had fixed him up with spinning and fly spoon tackle. I left ½ hour later but could not move anything either spinning or with fly till 11-30., then by careful fishing, sitting low in the boat, had some good sport with a 5 lb. carp on my trout rod. Had lunch in a big gorge which looked like fish, but nothing doing and fish went clean off as soon as the sun got off the water. W caught me up 3 p.m. having gone as far up the Macrup as he could get his boat; he had 2 fish, caught spinning.

Macrup, last day. Left early upstream for a short day, water far clearer and dropping rapidly. W came up and we lunched together. Nothing doing in the morning; worked hard with the fly but fish kept coming short and only got three just before returning to camp 3-30 p.m. We then got down to sorting things and making a list of what we were leaving for E & R.'

On Nov. 30 left our camp at Macrup Bridge standing for E and R who brought the boats back without any trouble, catching a few fish en route.

Our total catch in a week's fishing was 68 fish weighing 362 lb, the best for weight of any trip I did, as well as samples of nearly all the game to be found in these parts. We decided to do the round trip next year and explore a new river, the Irung.

(*To be continued*)

SURVEY OF ECONOMIC VEGETABLE PRODUCTS OF JAMMU AND KASHMIR

1. SINDH FOREST DIVISION

BY

L. D. Kapoor, R. N. Chopra and I. C. Chopra

(Drug Research Laboratory, Jammu and Kashmir)

(With a sketch map)

The Sindh Forest Division lies to the north-east of Kashmir valley between lat. 34° 7′ & 34° 37′ N. and long. 74° 36′ E. Its boundaries touch the outskirts of Srinagar city and Baramulla Tehsil of Kashmir Province.

The area is bounded on the north-east by the great Himalayan Range which separates the water-sheds of the Kishanganga river from those of Jhelum River. This division includes Gurez, Dras and Warwan *illaqas* and areas right up to Gilgit and Kargil on the north, and the Dachigam Rakh and the Dara nala right up to Srinagar municipal limits and the Jhelum river on the south. It is separated from the Kamraj division in the west by a chain of hills starting from Miyanigul and sweeping gracefully down to the pyramidal hillock of Baba-Shukar-Din on the banks of Wular Lake

The main topographical features are the great Himalayan Range in the north-east and the numerous marshes and lakes in the south, with two main series of mountains running from the east to west and enclosing the Sindh valley. The northern range branches off near Barihal into two main ridges; one of these extends right upto Kazinag and the other with its everlasting snows of the Harmukh (16,903 ft.) ends at the domeshaped hills of Manashbal. From these slopes, and especially from the top of Harmukh, numerous streams start and radiate in all directions and eventually empty themselves into the Wular or into the Sindh river.

The jurisdiction of the Sindh Forest Division has lately been extended from the Kamri and Burzil passes to the inner dry valley of Astore right up to Bunji. Herein lies the peak of Nanga Parbat (26,182 ft.). This inner dry valley is fed by the Astore river and many other streams coming from the glaciers of Nanga Parbat and Burzil mountains. The Astore river pours into the Indus at the Partap Bridge near Bunji. The major part of this area is a dry rocky tract with sand in the valleys and of a bleak and rugged appearance.

The elevation ranges from 5,200 ft. at Zurimanz on the Wular to 26,182 ft. on the Nanga Parbat. The forests lie mainly on the northern and eastern aspects of the valleys at altitudes between 6,000 to 11,000 ft.

This is the richest forest division of Kashmir well known for its natural resources because of its varied climate and abundance of minor forest products; Rhubarb, Colchicum, Aconites, Belladonna, Saussurea, Podophyllum, Male-fern, Juniperus, Artemisia, Valerian and many other plants of economic importance are here found in profusion. The area is not only rich in common herbs but also contains some rare plants such as Asafoetida and *Pinus gerardiana* which are not found in any other part of Kashmir.

In order to explore the possibilities of the exploitation of some of these common economic plants and to find some other plants of interest, a botanical excursion was arranged from Bandipore to Astore and back and from Srinagar to Vishnu-Sar via Sonemarg and back in the summer of 1946. The area traversed is shown in the attached map and represents the major part of the tract covered.

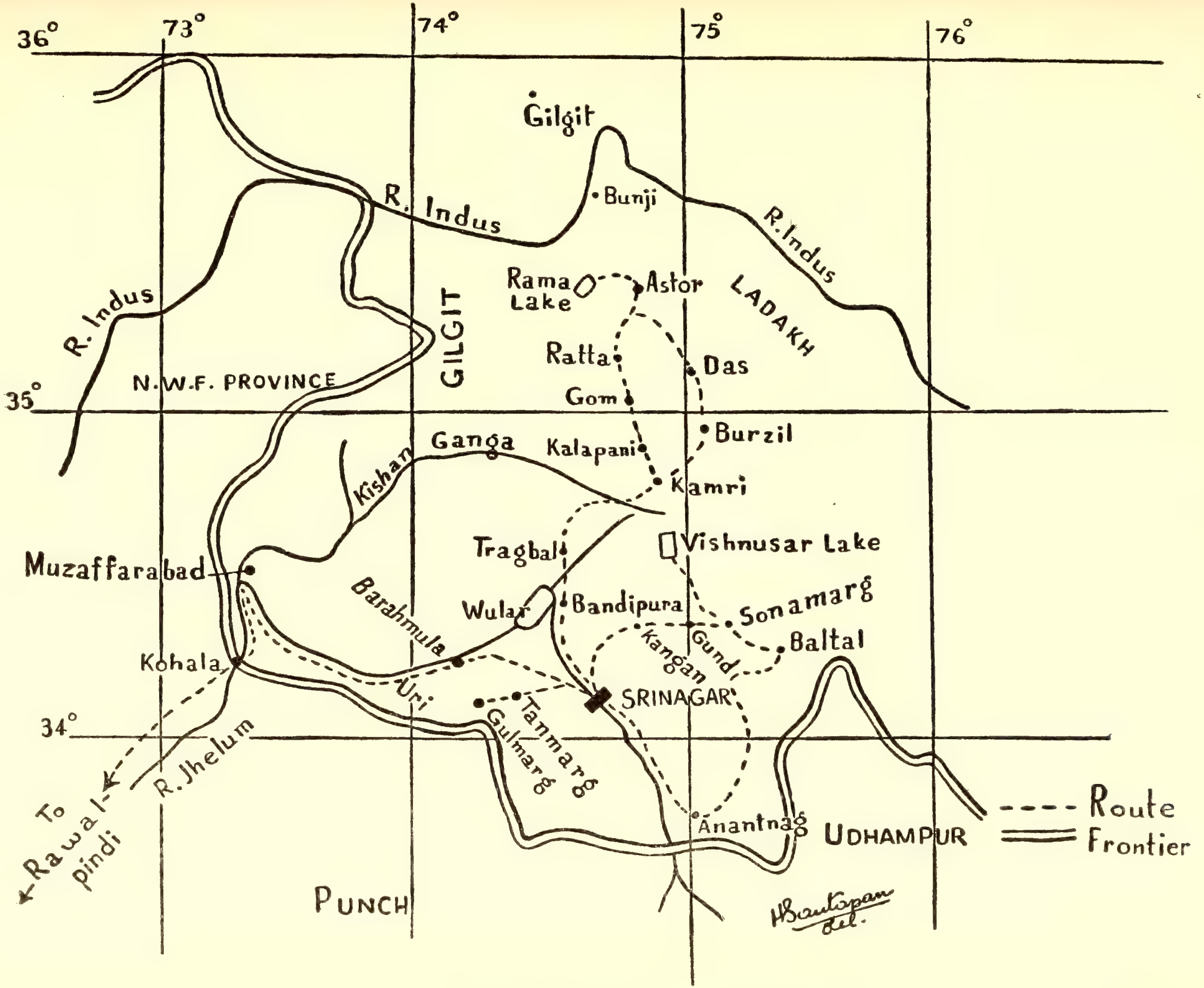
The party consisted of Dr. R. R. Stewart, Principal, Gordon College, Rawalpindi, Mrs. Stewart, Prof. Nasir of Gordon College, Dr. Stuenz and his wife. The authors acknowledge with thanks the help received from Dr. Stewart and Prof. Nasir by way of determination of plants collected. The other members of the party were also interested in natural history, particularly in birds, etc. They all contributed towards the information recorded here.

Bandipore is connected with Srinagar by a 34 miles long, direct motor road and also by the river Jhelum and the Wular Lake, and from here starts the road to Gurez and Astore valleys. Chatternar, situated at the head of the Wular Lake commands a wonderful view of the lake which supplies the adjoining areas with such economic products as *Nelumbium speciosum, Trapa bispinosa* and *Typha,* the cat-tail which is used in the manufacture of the mats so largely used locally. This grass-like plant and other aquatic weeds are harvested from the Wular Lake for use as fodder and manure. The Forest Department maintains the Ningli plantation for raising different species of willow for commercial purposes. Bandipore has a vegetation similar to the Dal Lake near Srinagar. Trees of *Punica granatum, Zizyphus jujuba, Salix* sp., *Morus alba*, etc. and several other species occur in this area. Rice, wheat, barley and maize are cultivated around Bandipore.

As the route ascends from Bandipore to Tragbal, the forest flora of this region comes into evidence. The maize and rice fields are left behind and *Pinus excelsa* with its undergrowth of *Stipa sibirica, Viburnum nervosum* and *Parrotia jacquemontiana* are met with. The timber from *Pinus excelsa* is very useful and contributes largely to the State revenue. *Stipa sibirica* is a grass poisonous to livestock containing cyanogenetic glucosides. *Parrotia jacquemontiana* (Hatab) is a common slow growing tree or large shrub yielding a wood useful for the manufacture of tool handles and also for fuel.

From Bandipore there is a steep ascent of about 12 miles to Tragbal. It commands a beautiful view over the river Jhelum as it runs into and emerges out of the Wular Lake, and also of the adjoining valley surrounded by the snow covered range of the Pir Panjal.

Tragbal (9,000 ft.) is a small meadow at the base of the Rajdhani Pass which is nearly 12,000 ft. high. *Abies pindrow* is the common fir growing here along with broad-leaved trees like *Juglans regia, Betula utilis, Prunus padus, Acer pictum* etc. The road passes through



JAMMU AND KASHMIR

forests of *Pinus excelsa* on both the eastern and southern aspects of these mountains.

The ascent to Rajdhani Pass leads through beautiful open meadows on which amongst many other plants are found *Verbascum thapsus*, as well as *Jurinea macrocephala* (Dhup) used commonly as incense.

Some trees of *Pinus excelsa* were seen attacked by *Arceuthobium minutissimum*, a minute parasitic plant which kills the trees. *Sambucus wightiana*, commonly known as 'faklua', due to its unpleasant smell is very common in the tract. *Impatiens roylei, Artemisia grata, Senecio jacquemontiana, S. chrysanthemoides, Lindefolia longiflora* and *Cynoglossum* sp. were also very common on both sides of the path leading to Rajdhani Pass.

The top of Rajdhani or Rajdhiangan is an open meadow. Here at about 12,000 ft. is a junction of different routes coming from Gilgit, Bandipore, Viji and Basam Gali. *Pedicularis* sp., *Chaerophyllum* sp., *Saussurea lappa, Polygonum alpinum, Phlomis bracteosa, Euphorbia wallichii, Saxifraga ligulata, Sedum* sp., *Achillea millefolium*, and *Carum carvi* were among the common plants seen here.

From Rajdhani the road zigzags down through commercial and non-commercial forest belts of *Abies pindrow* and reaches Koragbal and on to Kanzalwan where the river Kishanganga turns and flows towards Keran Division. The forest flora along the roadside is rich and includes the plants mentioned above and many more.

At Koragbal *Artemisia brevifolia* Wall. is seen growing wild in profusion. This plant is common in the Gurez and Rattu valleys and it is annually collected for the manufacture of santonine at Baramulla. A stream running from Viji (13,000 ft.) to Koragbal (8,000 ft.) and flowing past its rest house was also explored, and among others *Dryopteris odontoloma, Aileantum patatum, Valeriana wallichi, Achillea millefolium, Orobanche* sp., *Saussurea lappa* and many other plants mentioned in the appendix were collected.

The main road runs along the river upto Badwan and Gurez valley 8,000 ft. and then crosses the river Kishanganga. The Gurez valley is a narrow strip surrounded by hills with a meadow and river Kishanganga running through and *Populus alba* and *P. ciliata* growing in abundance. Visitors often camp in this area and enjoy trout fishing in streams maintained by the Forest Department. The Gurez valley is surrounded by hills on all sides and is rich in vegetation. *Sambucus wightiana, Brunella* sp., *Swertia* sp. and *Jaeskia gentianoides* grow profusely here. *Euphrosia officinalis* and *Senecio thomsoni* are common in Badwan and so also is Red clover (*Trifolium* sp.) which is good fodder for livestock. Along the road from Badwan to the Kamri Rest House (9,000 ft.) some arable fields are seen near Dawar, Churwan and Kamri villages where *Fagopyrum esculentum, Solanum tuberosum* and barley are cultivated by the local people for food.

At Churwan a path leads to the Talil valley which is visited by a large number of shepherds with large flocks of sheep. Adjacent to Talail valley lies Vishnusar which is easily accessible via Sonemarg. In the fields and round about the main route *Carum carvi* (Zira) of good quality with strong aroma commonly grows, and this is harvested for marketing in Kashmir where it is well known as 'Zira of Gurez'.

As the road to Kamiri ascends along the river Kishanganga the belt of *Abies pindrow* is left behind and scattered trees of *Juniperus macropoda* are seen commonly up to the rest house at the Kamiri Pass. *Juniperus* forms a small thin forest crop in this area. Its seeds yield the essential oil which is used in the preparation of gin and for flavouring liquors. The wood can best be utilized for the manufacture of pencils. *Prangos pabularia* and *Aconitum chasmanthum* occur in fairly large quantities. *Prangos* is aromatic and locally serves as a good dry fodder for livestock in winter. *Aconitum chasmanthum* root finds a good market as an Indian substitute for the officinal Aconite. *Artemisia brevifolia* is abundant in this area and is collected commercially. *Codonopsis* sp., *Nepeta* sp. and *Heracleum* sp. were also common in this part of the tract. Kamiri rest house at 10,000 ft. is situated amidst fir and *Betula utilis* (Bhojpatra) trees.

Kamiri Pass is about 6 miles from this rest house and the bridle path has profuse vegetation right up to the top. Among others which have been recorded near Rajdhani, *Valeriana pyrolaefolia*, *V. hardwickii*, *Aquilegia fragrans*, *Polygonatum geminifolium*, *Onosma echiodes*, *Thalictrum minus*, *Sedum* sp. *Saxifraga* sp. *Paraquilegia* sp., *Primuloides*, *Senecio jacquemontiana*, *Artemisia parviflora*, *A. laciniata*, *Saussurea lappa* and other species of *Saussurea*, *Picrorhiza Kurrooa*, *Macrotomia benthami*, *Juniperus squamata*, etc., need mention. A detailed list is appended.

From the Kamiri Pass on clear days an excellent view of Nanga Parbat (26,740 ft.) to the north and Harmukh (16,700 ft.) to the south is obtained.

Kamiri Pass is the boundary line of the Gurez range and as the descent begins on the other side of the pass we enter the Astore range. From the pass there is a zigzag descent of 7 miles to Kalapani Rest House. *Aconitum heterophyllum*, *A. chasmanthum* and *Scrophularia griffithii* are common and so are *Pedicularis* sp. and *Senecio chrysanthemoides*, etc. This side of the pass presents chiefly rocks with only humble vegetation over it; hence the name Kala Pani. The trees of *Betula utilis* are only seen in small patches along with fir trees.

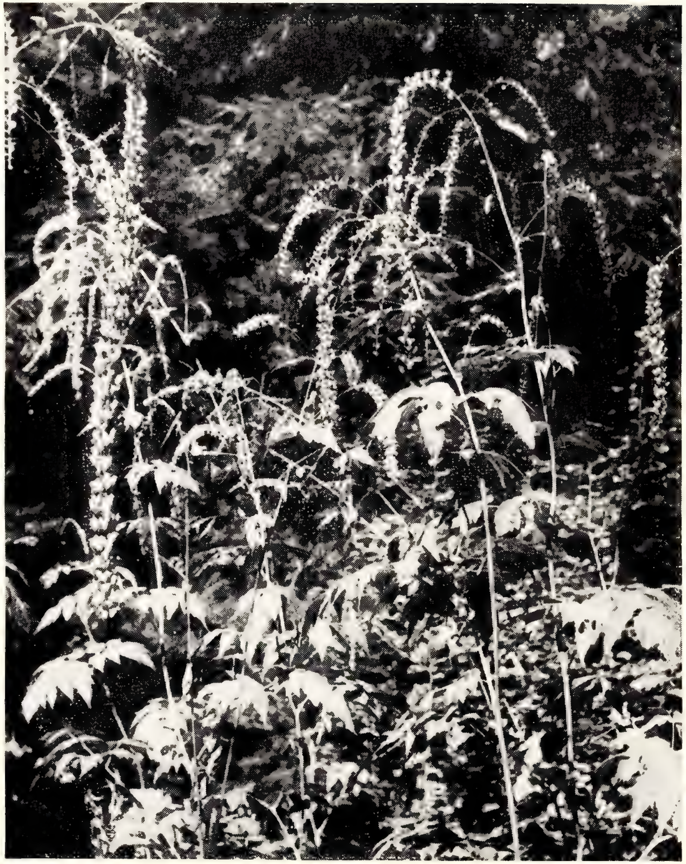
Kalapani (10,000 ft.) is rich in alpine flora. The water here contains silica and needs filtration before it can be used for drinking purposes. There is no village near Kalapani except at Chachri-Kadal about 8 miles distant. *Heracleum* sp., *Lindelofia longiflora*, *Cynoglossum*, *Cerastium*, are common near the rest house. *Artemisia brevifolia* is not seen from Kamiri Rest House to Chachri-Kadal but it makes its appearance only beyond Chachri-Kadal right upto Rattu and Rampore where it grows profusely. That it does not grow between Kamiri and Chachri-Kadal may be due to the fact that it is more xerophytic; near the pass there is much moisture until July. The route leading from Kalapani to Rattu passes through barren areas excepting near a few villages at Shankargarh etc., where wheat and barley are cultivated. *Hippophaë rhamnoides*, *Salix* sp. and *Artemisia brevifolia* are common all along the route. From Shankargarh again the peaks of Nanga Parbat are visible. The path leads along with Chachri-Kadal stream which later on joins the Astore river.

Rattu is one of the chief centres for the collection of *Artemisia*. *Pinus excelsa* is seen growing at Rattu. On the plateau at Rattu

Gurez Valley—Artemisia growing area.

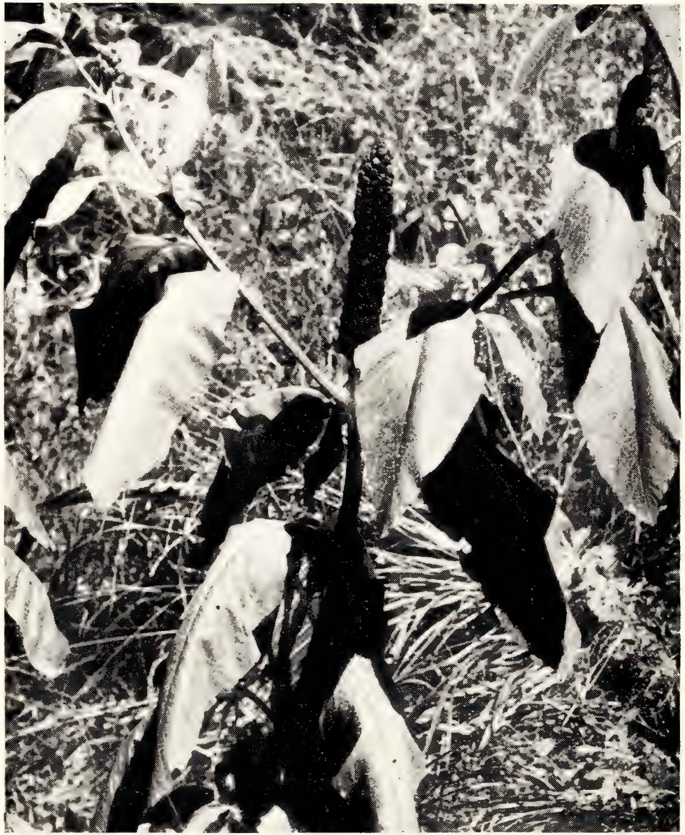
Photos *Author*

A view of Nichnai (12,000 ft.).



Photos

Cimicifuga foetida (flowering plants).



L. D. Kapoor

Phytolacca acinosa (fruiting) grows wild and is used for adulterating Belladonna roots and leaf.

(Cantt. area) *Scabiosa* sp. is very common. Rattu is mostly sandy and barren except for *Artemisia* and *Scabiosa*. The height of Rattu is 6,000 ft. and flora is representative of the inner dry valleys of the Himalayas.

As the route proceeds from Rattu to Rampore along the river, *Melilotus alba*, *Artemisia brevifolia*, *Hyoscyamus niger* and cultivated fields of barley, maize and potatoes are commonly met with. Scattered trees of *Pinus excelsa* and *Abies pindrow* are also found. Rattu *illaqa* is a favourite hunting place for ibex, etc. Rampore is about 10 miles from Rattu and here too the collection of *Artemisia* is carried on vigorously by the santonine manufacturers.

From Rampore a footpath leads to Tarshing and Rupal-nalla at the base of Nanga Parbat. The snow clad peaks of Nanga Parbat namely Dameir and Rakhiote present a marvellous view when the morning rays of the sun fall on them or when the light of full moon makes them glow.

Salvia glutinosa, *Chenopodium botrys* and *Nepeta* sp. and *Datisca cannabinna* were commonly seen while trekking from Zaipur village across the snout of the Nanga Parbat glacier to Tarshing village situated just at the base of Nanga Parbat and protected from glaciers by lateral moraines. Ice cold water oozes out at various places in this village obviously as a result of seepage from the glacier separated by the moraines. The Rupal-nalla beyond Tarshing, similarly presents beautiful views of the glaciers.

The commonest plant here is *Artemisia*. It is a very hardy weed and can stand the cold winds blowing from Nanga Parbat and also the drought in summer. Tarshing stream contains dirty glacier water and is utilised for irrigation purposes at some places. The water here is lacking in iodine and it generally causes goitre in the *illaqa* where it is used for drinking purposes.

The road leading from Rampur to Astore along the Tarshing nalla (later on known as Astore river when streams from Kamiri and Brizil meet at Gorikot) presents the inner dry valley vegetation. A thistle with globeshaped heads and *Anaphalis* and *Zizyphus* sp. are amongst the common vegetation on this route. At Gorikot it meets the main road from Burzil to Gilgit.

From Gorikot to Astore trees of *Pinus gerardiana* and *Juniperus macropoda* are again met with. This *illaqa* is otherwise sandy except at places where some irrigation is made possible and cereals are cultivated. It is very thinly populated; the inhabitants are related to the Chillas tribes.

Astore, a small village and the district headquarters, is situated at an altitude of 7,000 ft. above sea level with very scanty cultivation. *Pinus gerardiana* and *Juniperus macropoda* are used for house building as well as for fuel. There is no proper forest protection in this *illaqa*. Asafoetida (*Ferula narthex*) which is widespread at Harchoo beyond Astore, is allowed to go waste without extraction of its gum resin (Hing). *Abies pindrow* is found scattered here and there. Grape vines, apples and apricots are also grown here in small gardens.

At a distance of about 7 miles from Astore is situated Rama Lake. It is a small glacier lake at the base of Nanga Parbat on the northern side of Tarshing.

Juniperus recurva is very common at Rama. Along the path from Astore to Rama, *Hippophaë rhamnoides, Astragalus strobiliferus, Salix* sp. and *Pinus excelsa* were seen. *Pyrola rotundifolia* was also collected at Rama.

Pinus gerardiana seeds provide the 'Jalgoza' of commerce but they are not collected by the inhabitants for commercial purposes. *Juniperus macropoda* can yield a good wood for the manufacture of pencils, but the transport cost would be so prohibitive that it is not an economical proposition to exploit it.

Asafoetida (*Ferula narthex*) is common, and this is the only place in Kashmir where this plant is found in abundance. The gum resin popularly known as 'Hing' is commonly used in medicine and also for flavouring food articles. If exploited it would provide additional income to the inhabitants.

From Astore the party returned via Burzil pass (13,500 ft.). The track upto Gorikot from Astore was the same already trodden. From Gorikot to Godai along the Burzil stream the road is sandy for the major part. *Astragalus strobiliferus* and *Dephine oloides* is commonly seen here. *Astragalus strobiliferus* can yield the Indian substitute of the officinal gum Tragacanth. *Dephine* is a poisonous plant. Bupand valley near Godai is reported to be famous for big game and it is also reputed to be rich in medicinal plants such as *Saussurea lappa, Valeriana,* and *Angelica glauca* etc.

Passing through Khiram and Dass small villages where *Artemisia laciniata, A. amygdalina, A. parviflora* are growing wild, the route leads to Chillam Chowki. Hardly any growth except *Betula utilis, Salix* sp., and juniper trees are seen about here. The road further leads to Sirdar Kothi.

This part of the valley is quite rich in vegetation. Plants such as *Aconitum heterophyllum, A. chasmanthum, Pedicularis, Senecio chrysanthemoides, Corydalis* sp. were commonly seen. Most of these plants have been observed at Kamiri and Kalapani also.

From Sirdar-Kothi there is a gentle ascent to Burzil top at 13,800 ft. above sea-level. The top commands a good view on all sides. The snow clad peaks around add to the grandeur. As the road climbs down to Burzil Chowki it opens out into an area bedecked with the same alpine flora which we saw at Kamiri. From Burzil Chowki the belt of *Betula utilis* begins down to Pushwari where *Abies pindrow* appears. *Artemisia brevifolia* which has been left behind at Godai again appears at Minimarg. *Datisca cannabiana* was observed in many patches between Burzil Chowki and Minimarg. *Impatiens royleana* was in abundance near Minimarg and lower down the valley. The river Kishanganga passes by Minimarg and a road leads to Skardu from this junction. Pushawari which is the next halt is a small village surrounded by fir forests. *Angelica glauca* (chora) is found here in abundance. Its roots contain an essential oil. From Pushawari on to Dawar and Badwan the artemisia is common.

Behind Badwan Rest House a forest road leads to Viji and to Bandipore. This area is rich in Kuth and other medicinal plants mentioned previously and the forest contractors extract drug plants from this side in fairly considerable quantities.

The list of plants collected is given in the appendix. It is in no way an exhaustive list because only flowering plants at the time of our tour were collected. Medicinal plants such as *Belladonna, Lavetera, Podophyllum, Saussurea* etc. are annually collected from different localities of this valley by the Forest Department.

A motor road runs through the Sindh valley along the Sindh river from Srinagar to Sonemarg which is a developing health resort and attracts visitors in good numbers. This is the main route leading to Ladakh and Kargil in the north. The motor road now runs through Woyil, Kangan, Gund, Sonemarg and upto Dras. The land along the river is cultivated with maize, barley and wheat up to Gund. The local people at Sonemarg grow *Fagopyrum*, potatoes and barley. The average altitude ranges from 9,000 to 10,000 ft. at Sonemarg. Thajiwas provides a beautiful camping ground near Sonemarg at the base of glaciers. The streamlets from the Amarnath glaciers and Baltal feed the big Sindh stream.

The common plants collected on this way are also given in the appendix. A path leads from Sonemarg to Vishnusar lake which then continues to the Tilel valley and meets the Gurez valley on the north.

There is a steep path up to Sari village. *Sambucus wightiana* is common here. The path further leads to Nichni. It is surrounded by rocky mountains on all sides and a small stream flows by. On the way and passing through forests, plants like *Meconopsis aculeata, Aconitum laevi, Saussurea lappa, Salvia hiana, Artemisia grata* etc., were common. The Nichnai Pass is about 13,500 ft. The path leads to Vishensar at the base of Harmukh. Here are vast meadows where livestock graze.

Vishensar is a glacier lake at the base of the snow clad peaks. There is a foot path to cross this hill leading to Gangabal Lake which can also be approached via Kangan. *Juniperus recurva* and *Rhododendron* sp. are common in this region; they are only used as fuel by the shepherds and the graziers. *Stipa sibirica* is a common grass from Sonemarg to Baltal. It contains cynogenetic glucoside and is poisonous to livestock.

Sindh Forest Division abounds in economic plants. It is believed when more detailed and exhaustive excursions in different seasons are organised this list may be greatly increased. But it will suffice as a basis for future work.

Our thanks are due to Father H. Santapau for going through the manuscript and for his many helpful suggestions.

SYSTEMATIC LIST OF THE PLANTS OF SINDH DIVISION

In the following list plants are arranged according to the order of the families of Hooker's Flora of British India. The scientific name of the plant is given first in every case, then follows the synonym in a number of cases, lastly the exact localities where the plants have been found are mentioned.

RANUNCULACEAE

1. *Aconitum chasmanthum* Stapf ex Holmes.
   Kamari, Gurez, Burzil.
2. *Aconitum heterophyllum* Wall.
   Kamri, Kalapani, Burzil.

3. *Aconitum laeve* Royle.
   Baltal, Koragbal.
4. *Aconitum violaceum* Jacq.
   Sardar Kothi.
5. *Actaea spicata* Linn.
   Below Razdhanigan.
6. *Adonis chrysocyathus* Hook F. & T.
   Sonmarg, Nichnai.
7. *Anemone polyanthes* D. Don.
   Kamri.
8. *Anemone rupicola* Camb. var. *sericaea* H. & T.
   Kamri.
9. *Anemone tetrasepala* Royle.
   Nichnai.
10. *Aquilegia fragrans* Benth.
    Nichnai.
11. *Aquilegia jucunda* Fisch. & Mey.
    Kamri.
12. *Caltha palustris* Linn. var. *alba* Jacq
    Sonmarg, Nichnai.
13. *Clematis graveolens* Lind.
    C. connata DC. *grata* Wall.
    Astore. Gurikot.
14. *Clematis orientalis* Linn.
    Koragbal.
15. *Delphinium ranunculifolium* Wall.
    Sonmarg.
16. *Paeonia emodi* Wall.
    Gurez.
17. *Paraquilegia grandiflora* Drum. & Hutch.
    Kamri Pass.
18. *Ranunculus hirtellus* Royle.
    Kalapani.
19. *Ranunculus laetus* Wall.
    Baltal, Koragbal.
20. *Ranunculus munroanus* J. R. Drumm.
    Kamari Pass.
21. *Ranunculus trichophyllus* Chais.
    R. aquatilis var. *trichophyllus* H. & T.
    Rattu.
22. *Thalictrum cultratum* Wall.
    Kamri.

23. *Thalictrum foetidum* Linn.
Gurez.

24. *Thalictrum minus* Linn.
Gurez.

25. *Trollius acaulis* Lindl.
Nichnai.

BERBERIDACEAE

26. *Podophyllum emodi* Wall.
Sonamarg, Serrai, Gurez.

PAPAVERACEAE

27. *Meconopsis aculeata* Royle
Nichnai, Razdhanigan.

CRUCIFERAE

28. *Arabidopsis himalaica* Edgew. O. E. Schula.
Sisymbrium himalaicum H. & T.
Baltal.

29. *Arabidopsis mollissima* O. E. Schulz.
Sisymbrium mollissimum C. A. Mey.
Pushwari.

30. *Arabidopsis thaliana* Schur.
Sisymbrium thalianum Gay & Monn.
Pushwari.

31. *Arabis glabra* Crantz.
Koragbal.

32. *Arabis tenuirostris* O. E. Schulz.
Rattu.

33. *Barbarea intermedia* Bureau.
Gurez.

34. *Barbarea vulgaris* Br.
Kamri.

35. *Brassica napus* Linn.
Gurez.

36. *Cardamine impatiens* Linn.
Baltal.

37. *Chorispora sabulosa* Camb.
Nichnai.

38. *Draba alpina* Linn.
Draba oreades Schrenk.
Kamri.

39. *Draba lanceolata* Royle.
Kamri.

40. *Draba nemorosa* Linn.
D. muralis Linn.
Tarshing.

41. *Draba obscura* Dunn.
Aphragmus obscurus Dunn O. E. S.
Kamri.

42. *Draba petraea* Baung.
Nichnai.

43. *Erysimum melicentae* Dunn.
Thlaspi cochlearioides Hk. f. & T.
Baltal, Zozila.

44. *Iberidella andersoni* Hook. f. & T.
Nichnai.

45. *Nasturtium palustre* DC.
Astore.

FUMARIACEAE

46. *Corydalis thyrsiflora* Prain.
Kamri.

47. *Corydalis govaniana* Wall.
Kamri.

48. *Corydalis ramosa* Wall.
Kamri, Sardarkothi.

VIOLACEAE

49. *Viola sylvatica* Fries.
Koragbal.

50. *Viola odorata* Linn.
Gurez.

CARYOPHYLLACEAE

51. *Arenaria Kashmirica* Edgew.
Rampore.

52. *Arenaria parviflora* Benth.
Rampore.

53. *Arenaria neelgerrensis* W. & A.
Kamri.

54. *Cerastium dahuricum* Fisch.
Kamri.

55. *Cerastium trigynum* Villars.
Koragbal.

56. *Caucalis latifolia* Linn.
Kamri.

57. *Lychnis nutans* Benth.
Kamri.

58. *Lychnis cachemeriana* Royle.
Koragbal.

59. *Silene inflata* Sm.
S. venosa Gilib.

60. *Silene Kunawarensis* Benth.
Rattu.

61. *Silene tenuis* Willd.
Kamri.

62. *Silene moorcroftiana* Wall.
Shankergarh.

63. *Stellaria crispata* Wall.
S. monosperma Buch. Ham.
Baltal.

64. *Stellaria cuspidata* Willd.
S. subumbellata Edgew.

65. *S. bulbosa* Wulf.
S. Davidi Var. himalaica French.
Kamri.

HYPERICACEAE

66. *Hypericum perforatum* Linn.
Rattu.

MALVACEAE

67. *Lavatera kashmiriana* Camb.
Gurez.

GERANIACEAE

68. *Geranium pratense* Linn.
Vishensar.

69. *Geranium Kishtvariense* Knuth.
Kamri.

70. *Geranium rectum* Trauty.
G. wallichianum D. Don.
Kalapani.

RUTACEAE

71. *Skimmia laureola* Hk. f.
Kangan.

BALSAMINACEAE

72. *Impatiens brachycentra* Kar. & Kir.
Sonemarg.

73. *Impatiens edgeworthii* Hook. f.

74. *Impatiens Flemingii* Hk. f.
Impatiens Roylei Walp.
J. glandulifera Royle.
Koragbal.

75. *Impatiens thomsoni* Hk. f.
Koragbal.

CELASTRACEAE

76. *Euonymus hamiltonianus* Wall.
Kamri.

RHAMNACEAE

77. *Rhamnus prostrata* Jaq.
Kamri.

78. *Rhamnus virgata* Roxb.
Chatternar and Haran.

SAPINDACEAE

79. *Acer caesium* Wall.
Baltal.

80. *Aesculus indica* Hiern.
Kangan.

PAPILIONACEAE

81. *Astragalus bicuspis* Fisch.
Rattu.

82. *Astragalus himalayanus* Klotz.
Koragbal.

83. *Astragalus longifolius* Lam.
A. longicaulis Barker.
Kamri.

84. *Astragalus orobrephes* W. Smith.
Astore.

85. *Astragalus oplites* Benth.
Pushwari.

86. *Astragalus peduncularis* Royle.
Astore.

87. *Astragalus rhizanthus* Royle.
Shankergarh.

88. *Astragalus royleanus* Bunge.
Pushwari to Gourikot.

89. *Astraglus strobiliferus* Royle.
Astore.

90. *Astragalus webbianus* R. Garh.
Gudei.

91. *Cicer soongaricum* Steph.
Pushwari.

92. *Colutea nepalensis* Sims.
Astore.

93. *Hedysarum astragaloides* Benth.
Rampore.

94. *Lotus corniculatus* Linn.
Koragbal.

95. *Medicago falcata* Linn.
Kamri, Gurez.

96. *Oxytropis thomsoni* Benth.
Kamri.

97. *Trigonella Emodi* Benth. var. *podperae* Sirjaev.
Gudei.

98. *Vicia faba* Linn.
Rampore.

99. *Vicia tenuifolia* Roth.
Shankergarh.

ROSACEAE

100. *Agrimonia pilosa* Ledeb.
Gurez and Koragbal.

101. *Alchemilla vulgaris* Linn.
Kamri Pass.

102. *Cotoneaster microphylla* Wall.
Rattu.

103. *Fragaria vesca* Linn.
Baltal, Sonamarg.

104. *Geum elatum* Wall.
Vishensar, Nichnai.

105. *Geum urbanum* Linn.
Vishensar.

106. *Potentilla argyrophylla* Wall.
Badwan.

107. *Potentilla curviseta* Hook. f.
Kamri.

108. *Potentilla desertorum* Bunge.
Badwan.

109. *Potentilla fragarioides* Linn.
Baltal.

110. *Potentilla gelida* C. A. Meyer.
Rampore.

111. *Potentilla kashmirica* Hook f.
Rampore.

112. *Potentilla leucochroa* Lindl.
Gurez.

113. *Potentilla multifida* Linn.
Rattu.

114. *Potentilla nepalensis* Hook.
Badwan.

115. *Potentilla reptans* Linn.
Pushwari.

116. *Potentilla sibbaldi* Haller. f.
Kamri Pass.

117. *Potentilla supina* Linn.
Kamri.

118. *Prunus jacquemontii* Hk. f.
Rampore.

119. *Rosa macrophylla* Lindl.
Baltal.

120. *Spiraea affinis* R. N. Parker.
Tarshing.

SAXIFRAGACEAE

121. *Parnassia affinis* Hk. f. and T.
Rampur.

122. *Ribes nigrum* Linn.
Rama, Astore.

123. *Ribes orientale* Desf.
Rampore.

124. *Saxifraga androsacea* Linn. var. *tridentata* Gaud.
Kamri pass.

125. *Saxifraga flagellaris* Willd.
Kalapani.

126. *Saxifraga ligulata* Wall.
Nichnai.

127. *Saxifraga odontophylla* Hk. f. & T.
Kamri.

128. *Saxifraga sibirica* Linn.
Kamri.

129. *Saxifraga stracheyi* Hook. f. & T.
Kamri.

CRASSULACEAE

130. *Sedum crassipes* Wall.
Kamri.

131. *Sedum ewersii* Ledeb.
Kamri.

132. *Sedum quadrifidum* Pall.
Vishensar.

133. *Sedum rhodiola* DC.
Kamri.

134. *Sempervivum acuminatum* Dcne.
Pushwari.

ONAGRACEAE

135. *Epilobium angustifolium* Linn.
E. latifolium Linn.
Sonamarg.

136. *Epilobium cylindricum* D. Don.
Below Kamri.

DATISCACEAE

137. *Datisca cannabina* Linn.
Badwan, Nichnai, Harn plantation.

UMBELLIFERAE

138. *Bupleurum canaliculatum.*
Gurez.

139. *Bupleurum lanceolatum* Wall.
Rattu.

140. *Bupleurum longicaule* Wall.
Kalapani.

141. *Bupleurum tenue* D. Don.
Koragbal.

142. *Bupleurum thomsoni* Clarke.
Kamri.

143. *Carum bulbocastanum* C. Koch.
Bunium persicum (Boiss.) Fd.
Koragbal.

144. *Carum carvi* Linn.
Ratu, Gurez.

145. *Angelica glauca* Edgew.
Pushwari.

146. *Archangelica himalaica* Clarke.
A. officinalis in Fl. Brit. Ind.
Koragbal.

147. *Chaerophyllum villosum* Wall.
Vishensar, Gurez.

148. *Eryngium coeruleum* Bieb.
Bandipur.

149. *Ferula narthex* Boiss.
Astore, Harchoo.

150. *Heracleum candicans* Wall.
Gurez.

151. *Heracleum thompsoni* Clarke.
Koragbal.

152. *Pleurospermum candollei* Benth.
Pushwari.

153. *Pleurospermum densiflorum* Benth.
Kamri Pass.

154. *Prangos pabularia* Lindl.
Kamri.

155. *Selinum papyraceum* Clarke.
Gudai.

156. *Selinum vaginatum* Clarke.
Pushwari.

157. *Vicatia coniifolia* DC.
Vishensar.

CAPRIFOLIACEAE

158. *Lonicera asperifolia* Hk. f. & T.
Shankergarh.

159. *Lonicera quinquelocularis* Hardw.
Shankergarh.

160. *Sambucus Wightianus* Wall.
Serrai Sonamarg.

161. *Viburnum nervosum* D. Don.
Below Tragbal.

RUBIACEAE

162. *Galium asperuloides* Edgew. (*triflorum* Michx.).
Gurez.

163. *Galium boreale* Linn.
Kalapani.

164. *Rubia cordifolia* Linn.
Sardar kothi.

DIPSACEAE

165. *Dipsacus inermis* Wall.
Kamri, Gurez.

166. *Scabiosa speciosa* Royle.
Koragbal, Kamri.

167. *Morina coulteriana* Royle.
Koragbal, Kamri, Rattu.

VALERIANIACEAE

168. *Valeriana dioica* Linn.
Kamri.

169. *Valeriana jaeschkii* Clarke.

170. *Valeriana pyrolaefolia* Decaisne.
Koragbal.

171. *Valeriana wallichii* DC.
Badwan.

COMPOSITAE

172. *Achillaea millefolium* Linn.
Koragbal.

173. *Anaphalis nubigena* DC.
Rama.

174. *Arctium lappa* Linn.
Koragbal.

175. *Artemisia brevifolia* Wall.
Gurez, Rattu.

176. *Artemisia dracunculus* Linn.
Rampore.

177. *Artemisia grata* Wall.
Nichnai.

178. *Artemisia laciniata* Willd.
Rattu, Gurez.

179. *Artemisia parviflora* Roxb.
A. japonica Thunb.
Rampore.

180. *Artemisia siversiana* Willd.
Gurez.

181. *Artemisia vestita* Wall.
Pushwari.

182. *Aster falconeri* Butch.
Kamri.

183. *Aster flaccidus* Bunge.
A. heterochaeta Benth.
Vishensar.

184. *Aster molliusculus* Wall.
Kamri.

185. *Carduus nutans* Linn.
Kamri.

186. *Cousinea thomsoni.*
Gudai.

187. *Cremanthodium decaisnei* Clarke.
Pushwari.

188. *Doronicum Roylei* DC.
Kamri.

189. *Erigeron andryaloides* Benth.
Rampore.

190. *Erigeron multicaulis* Wall.
Tarshing.

191. *Erigeron patentisquama* J. F. Jeffrey.
Shankergarh.

192. *Erigeron multiradiatus* Benth.
Kamri.

193. *Gnaphalium stewartii* Clarke.
Rama.

194. *Inula obtusifolia* Kerner.
Tarshing.

195. *Inula racemosa* Hook.
Gurez.

196. *Inula rhizocephaloides* C. B. Clarke.
Rama.

197. *Inula royleana* DC.
Pushwari.

198. *Jurinea ceratocarpa* Benth.
Pushwari.

199. *Jurinea macrocephala* Benth.
Burzil. Raz-Dhani.

200. *Lactuca longifolia* DC.
Rattu.

201. *Lactuca lessertiana* Clarke.
Kamri.

202. *Lactuca scariola* Linn.
Rampore.

203. *Saussurea candolleana* Wall.
Kamri pass.

204. *Saussurea falconeri* Hk.f.
Sardarkothi.

205. *Saussurea lappa* Clarke.
Gurez.

206. *Scorzonera divaricata* Turcz.
Rampore.

207. *Senecio jacquemontianus* Benth.
Koragbal, Razdhani.

208. *Senecio pedunculatus* Edgew.
Tarshing.

209. *Senecio thompsoni* Clarke.
Badwan.

210. *Solidago virga-aurea* Linn.
Kamri.

211. *Tanacetum falconeri* Hk. f.
Burzil.

212. *Tanacetum longifolium* Wall.
Burzil.

213. *Taraxacum officinale* Wigg.
Kamri, Gurez.

214. *Tragopogon pratense* Linn.
Badwan.

215. *Tussilago farfara* Linn.
Astore.

ERICACEAE

216. *Pyrola rotundifolia* Linn.
Thajwas, Sonamarg.

217. *Rhododendron arboreum.*
Kamri.

218. *Rhododendron campanulatum* D. Don.
Nichnai.

CAMPANULACEAE

219. *Campanula aristata* Wall.
Kamri.

220. *Campanula cashmiriana* Royle.
Kamri.

221. *Campanula colorata* Wall. var. *tibetica* H.f. & T.
Kamri.

222. *Codonopsis ovata* Benth.
Koragbal, Charwan.

223. *Codonopsis clematidea* Schrenck.
Badwan. Charwan.

224. *Codonopsis rotundifolia* Benth.
Koragbal, Charwan.

PRIMULACEAE

225. *Androsace duthieana* R. Kunth.
Kamri.

226. *Androsace mucronifolia* Watt.
Baltal.

227. *Androsace primuloides* Duby.
Kamri.

228. *Androsace rotundifolia* Hardw.
Kamri.

229. *Androsace sempervivoides* Jacquem.
Vishensar.

230. *Cortusa matthioli* Linn.
Kamri.

231. *Primula denticulata* Sm.
Vishensar.

232. *Primula elliptica* Royle.
Kamri.

OLEACEAE

233. *Fraxinus xanthoxyloides* Wall.
Gudai.

ASCLEPIADIACEAE

234. *Cynanchum glaucum* Wall.
Shankergarh.

235. *Cynanchum jacquemontianum* Decne.
Kamri.

GENTIANACEAE

236. *Gentiana carinata* Griseb.
Vishensar.

237. *Gentiana decumbens* Linn.
G. Thianshanica Rupr.
Burzil, Gurez.

238. *Gentiana marginata* Griseb.
Kamri.

239. *Gentiana stracheyi* C. B. Clarke.
Gentiana serrata Gunner. var. *stracheyi* Clarke.
Rampore.

240. *Jaeschkea gentianoides* Kurz.
Koragbal, Badwan.

241. *Swertia perfoliata* Don.
Shankergarh.

242. *Swertia petiolata* Royle.
Pushwari.

243. *Swertia thomsoni* Clarke.
Rampore.

POLEMONIACEAE

244. *Polemonium coeruleum* Linn.
Nichnai.

BORAGINACEAE

245. *Cynoglossum micranthus* Desf.
C. lanceolatum Forsk.
Sonemarg.

246. *Cynoglossum wallichii* G. Don.
Koragbal.

247. *Echinospermum barbatum* Lehm.
Kamri.

248. *Eritrichium strictum* Dcne.
Sonamarg.

249. *Lindelofia angustifolia* A. Brand.
Kamri.

250. *Lindelofia longiflora* Baillon.
Vishensar, Nichnai.

251. *Macrotomia benthami* DC.
Vishensar.

252. *Myosotis sylvatica* Linn.
Nichnai.

253. *Onosma kashmirica* Johnnston
O. echioides.
Kamri.

SCROPHULARIACEAE

254. *Digitalis purpurea* Linn.

255. *Euphrasia officinalis* Linn.
Kalapani, Badwan.

256. *Leptorhabdos benthamiana* Walp.
Pushwari.

257. *Pedicularis bicornuta* Klotzsch.
Shankergarh.

258. *Pedicularis pyramidata* Royle.
Kalapani.

259. *Pedicularis pectinata* Wall.
Gurez.

260. *Pedicularis verticillata* Linn.
P. roylei Maxim.
Pushwari.

261. *Pedicularis siphonantha* D. Don.
Kamri.

262. *Pedicularis pycnantha* Boiss.
Rampore.

263. *Picrorhiza kurrooa* Benth.
Kamri, Gurez.

264. *Scrophularia himalensis* Royle.
S. polyantha Royle.
Koragbal.

265. *Verbascum thapsus* Linn.
Sonamarg.

266. *Veronica becabunga* Linn.
Astore, Rama.

267. *Veronica deltigera* Wall.
Kalapani.

268. *Veronica hirta* Pennell.
Kamri.

269. *Veronica serpyllifolia* Linn.
Nichnai.

OROBANCHACEAE

270. *Orobanche cernua* Loeffl.
Kamri.

271. *Orobanche orientalis* Beck.
Kamri.

LORANTHACEAE

272. *Viscum album* Linn.
Gurez.

LABIATAE

273. *Calamintha clinopodium* Benth.
Sonamarg.

274. *Dracocephalum nutans* Linn.
Sonamarg.

275. *Elsholtzia cristata* Willd.
Sonamarg.

276. *Elsholtzia densa* Benth.
Sonamarg.

277. *Lamium album* Linn.
Gurez, Haran.

278. *Mentha arvensis* Linn.
Gurez.

279. *Mentha sylvestris* Linn.
Gurez.

280. *Nepeta clarkei* Hk.f.
Koragbal.

281. *Nepeta connata* Royle.
Kalapani.

282. *Nepeta eriostachya* Benth.
Koragbal.

283. *Nepeta glutinosa* Benth.
Rampore.

284. *Nepeta govaniana* Benth.

285. *Nepeta salviaefolia* Royle.
Tarshing.

286. *Origanum vulgare* Linn.
Kamri.

287. *Phlomis bracteosa* Royle.
Nichnai.

288. *Phlomis setigera* Falc.
Koragbal.

289. *Salvia glutinosa* Linn.
Rampore.

290. *Salvia hians* Royle.
Nichnai.

291. *Salvia moorcroftiana* Wall.
Bandipore, Ganderbal.

292. *Scutellaria prostrata* Jacquem.
Kamri, Gurez.

293. *Stachys sericea* var. *alpina*.
Koragbal.

294. *Stachys sericea* Wall.
Baltal.

295. *Thymus serpyllum* Linn.
Gurez.

CHENOPODIACEAE

296. *Chenopodium album* Linn.
Astore, Bandipore.

297. *Chenopodium blitum* Hk.f.
Kamri, Charwan.

298. *Chenopodium botrys* Linn.
Rampore.

299. *Kochia prostrata* Schrad.
Rampore.

300. *Atriplex crassifolia* Camb.
Gudai.

POLYGONACEAE

301. *Polygonum affine* D. Don.
Vishensar.

302. *Polygonum alpinum* All.
Koragbal.

303. *Polygonum amplexicaule* D. Don.
Vishensar.

304. *Polygonum viviparum* Linn.
Vishensar.

305. *Polygonum dumetorum* Linn.
Budwan, Minimarg etc.

306. *Polygonum paronychioides* C. A. Mey.
Gurez.

307. *Polygonum lapathifolium.*
Pushwari.

308. *Polygonum persicaria* Linn.
Tarshing.

309. *Polygonum rumicifolium.*
Kamri.

310. *Polygonum tortuosum* D. Don.
Rampore.

311. *Rheum emodi* Wall.
Rheum Webbianum Royle.
Gurez.

312. *Rumex acetosa* Linn.
Koragbal.

ELEAEGNACEAE

313. *Hippophaë rhamnoides* Linn.
Shankergarh, Rama.

EUPHORBIACEAE

314. *Euphorbia cornigera* Boiss.
Koragbal.

315. *Euphorbia pilosa* Linn.
Shankergarh.

316. *Euphorbia wallichii* Hk. f.
Kamri.

URTICACEAE

317. *Cannabis sativa* Linn.
Ganderbal.

318. *Morus alba* Linn.
Ganderbal.

319. *Celtis australis* Linn.
Bandipore.

PLATANACEAE

320. *Platanus orientalis* Linn.
Ganderbal.

JUGLANDACEAE

321. *Juglans regia* Linn.
Gurez and Kangan.

CUPULIFERAE

322. *Betula utilis* D. Don.
Burzil, Kalapani.

323. *Corylus colurna* Linn.
Kangan.

SALICACEAE

324. *Populus alba* Linn.
Ganderbal.

325. *Populus nigra* var. *pyramidalis* Spach.
Astore.

326. *Salix alba* Linn.
Ganderbal.

327. *Salix flabellaris* Anders.
Nichnai.

328. *Salix hastata* Linn.
Kamri.

329. *Salix lindleyana* Wall. var. *latifolia* Parker.
Kamri.

330. *Salix tetrasperma* Roxb.
Nichnai.

CONIFERAE

331. *Abies webbiana* Lindl.
Gurez, Astore.

332. *Cedrus deodara* Hook. f.
Krishanaganga valley.

333. *Juniperus communis* Linn.
Rampore.

334. *Juniperus macropoda* Boiss.
Kamri.

335. *Pinus excelsa* Wall.
Sindh valley.

336. *Pinus gerardiana* Wall.
Astore.

337. *Taxus baccata* Linn.
Gurez and Astore.

ORCHIDACEAE

338. *Orchis latifolia* Linn.
Kamri, Rattu and Badwan.

IRIDACEAE

339. *Iris hookeriana* M. Fost.
Nichnai.

LILIACEAE

340. *Allium semenovii* Regel.
Kamri.

341. *Allium rubellum* M. Bieb.
Rampore.

342. *Eremurus himalaicus* Baker.
Kamri, Burzil and Gurez.

343. *Colchicum luteum* Baker.
Gurez.

JUNCACEAE

344. *Juncus himalensis* Klotzsch & Garcke.
Burzil.

345. *Juncus membranaceus* Royle.
Tarshing.

ARACEAE

346. *Arisaema wallichianum* Hook. f.
Koragbal.

NAIADACEAE

347. *Triglochin palustre* Linn.
Kamri.

GRAMINEAE

348. *Panicum miliaceum* Linn.
Astore.

FILICES

349. *Dryopteris brunoniana* C. Chr.
Vishensar.

350. *Dryopteris blanfordii* C. Chr.
Koragbal.

351. *Dryopteris filix-mas* sens. lat.
Gurez.

352. *Asplenium viride* Hudson.
Kamri.

STUDY OF THE MARINE FAUNA OF THE KARWAR COAST AND NEIGHBOURING ISLANDS

BY

A. M. PATIL, M.SC.

(Department of Biology, Karnatak College, Dharwar)

PART I: PROTOZOA TO ARTHROPODA

(With a map)

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I. INTRODUCTION

Most of the available knowledge of the fauna of the west coast of India is confined to the narrow limits of fishes, as such work was undertaken mainly by the Departments of Fisheries of the several States bordering the coast. The present work was undertaken with a view to study the fauna from an academic standpoint. Karwar being the nearest coastal town from Dharwar and exhibiting various types of ecological conditions, was chosen for study. The marine fauna of the Karwar coast has not been investigated by any zoologist so far. In 1940, however, two naturalists, Dr. Maurice Suter and Mr. Charles McCann, made certain observations which were mainly concerned with the angling of fishes and the inland fauna of the place.

With a view to collect a comprehensive knowledge of the fauna, several trips, arranged during the various seasons of the year, were carried out and these have given an idea of the seasonal fluctuations of the marine life of this coast. The animals were studied with reference to their natural surroundings, and in the present paper, no attempt has been made to study the detailed systematics of the specimens collected. Such a study has, however, been started with some groups, particularly the Mollusca, and the account will be published in due course.

The paper is written with a view to facilitate any biologist who may be interested to collect and study the forms available in this area. Hence, some of the conspicuous features of many of the animals have been included. Wherever possible the ecological conditions have also been alluded to.

I wish to express my indebtedness to Prof. P. W. Gideon, M.A., Head of the Department of Biology, Karnatak College, Dharwar, who introduced me to this interesting study by initiating and joining the collection trips and for helping me in various ways throughout the period of study. I am equally indebted to Dr. J. P. Joshua, M.A., Ph.D., Professor of Zoology, Madras Christian College, Tambaram, for his keen interest in my work and for guiding me in the field work as well as laboratory study. My thanks are also due to my colleague, Shri H. V. Kashyap, M.Sc., for his helpful suggestions in preparing the manuscript. I also wish to thank my colleagues and students who joined me in the collection trips and enriched the collections.

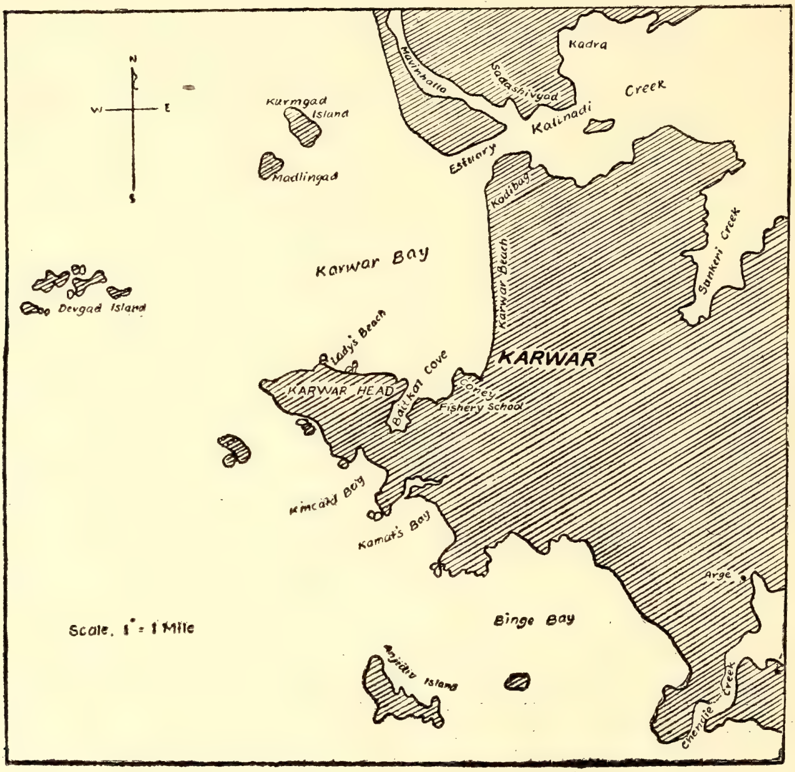
II. METHODS OF COLLECTION

Most of the shore collection was made at low tide. In sandy areas, the specimens were collected by hand or digging with a spade. In rocky areas, the hammer and chisel were used for removing the animals which were firmly attached to the rocks. The nets drawn by the fishermen to the beach were also examined. Plankton collections were made from the open sea by using a fine bolting silk tow-net, dragged along by the local boats fitted with outriggers. Usually the plankton was collected at intervals throughout the night. Specimens were also collected by dredging at certain areas in the Karwar Bay. An iron dredge measuring 2 ft. by 1 ft., with a string net of close mesh reinforced by a coir netting of large mesh, was used for the purpose.

III. CONDITIONS ON THE KARWAR COAST

Karwar, the headquarters of North Kanara District, is about 300 miles south of Bombay (latitude 14° to 15°N; longitude 74° to 75°E). The entire coast is hilly and rocky and at many points steep hills rise straight up from the sea. At the southern end a piece of land juts into the sea and is known as the Karwar Head, the shores of which are all rocky. On the northern side of Karwar Head, however, is a small sandy beach—Lady's Beach—hemmed in between two large projections of rocks. Between the Karwar Head and the mainland is an extension of the Karwar Bay, which is known as the Baitkal Cove. This cove is shallow and has a muddy bottom and nearly half of it is exposed at low tide. On the west and parallel to the town stretches the long sandy Karwar Beach, extending from the mouth of the river Kalinadi in the north to Coney Point in the south. This beach is about three miles in length and is the longest sandy beach near about Karwar.

About three miles north of Karwar town is the village, Kodibag, which is situated on the bank of the Kalinadi estuary. On the opposite bank is the small town, Sadashivgad. To the west of Sadashivgad is a small stream called Mavin Halla, which enters the Kalinadi river just before it joins the sea. At low tide a large extent of this stream is exposed forming a rich collecting ground of estuarine forms. Further up the river, on the northern bank, near the village Kadra, there is a vast muddy area which is exposed at low tide. On the southern bank, opposite the Kadra area, is a long muddy creek of the river extending for about two miles in a southern direction. This is the Sunkeri Creek. The fauna in both these areas, as also on the small mud-banks situated in the river and exposed at low tides, is very similar.



Karwar Coast and neighbouring Islands.

In Karwar Bay there is a cluster of islets known as Oyster Rocks. On the largest of these, Devgad Island, about seven miles west of the mainland a light-house has been built. About four miles north-east of these rocks are situated two more islets known as Madlingad and Kurmugad. Five miles south-west of Karwar and about two miles from the mainland there is a Portuguese island known as Anjidiv.

Along the road to Ankola, the rocky coast is broken up by several sandy beaches which are placed in between groups of rocks that jut into the sea. The first of these sandy beaches is called Kincaid's Bay and is about a mile from the town. Further down about two miles and three miles from the town, are Kamat's Bay and Binge Bay respectively. The majority of the animals recorded in this paper have been collected from Kamat's Bay. About five miles from Karwar, on the road to Ankola, is the village Arge.

Between this village and the sea, there is an expansive flat sandy area (about 6 sq. miles), through the middle of which a narrow stream meanders into the sea. This area called the Chendie Creek is completely submerged at high tide.

Thus Karwar presents a variety of ecological conditions showing a representative marine fauna. There are sandy beaches, rocky shores, islands, coves, creeks, an estuary, mud-flats and marshes, all within easy reach of the town.

IV. Systematics

PROTOZOA

All the Protozoans recorded were from the plankton collected in Karwar Bay. The majority of the forms are flagellates belonging to the genera : *Noctiluca, Ceratium, Gymnodinium* and *Peridinium. Noctiluca* has been observed in large numbers and they can easily be recognised at night by the bio-luminiscence they exhibit whenever the surface water is disturbed. *Ceratium* is represented by three species : *C. tripos, C. fusus,* and *C. furca.*

Radiolarians were represented by the genus, *Acanthometra,* which were seen in quite good numbers, especially in the plankton collected at midnight. Sometimes, a few living Foraminifera have also been observed in the plankton. Large numbers of their skeletons, however, are washed ashore and can be seen if a sample of sand is examined under the microscope. The Ciliates are represented only by the Vorticellids attached to bits of sea-weeds.

PORIFERA

No special search for sponges has been made, but a few pieces washed ashore and some encrusting on the rocks have been collected. *Adocia* is the encrusting form found on the rocks of Kamat's Bay and Binge Bay. It may be orange, yellow, green or blue in colour. *Halisarca* is the one that is usually washed ashore and has been collected at Kamat's Bay and Anjidiv island. It consists of small branches with conspicuous oscula.

COELENTERATA

Coelenterates are well represented in Karwar. They include the representatives of all the four classes of the phylum except the corals, which have not been observed in a living condition at all, but a few pieces of dead coral have been collected occasionally on the shore. The most familiar coelenterate, however, is the jelly-fish.

HYDROZOA :

Sertularia is the most common form found beneath the rocks on all the rocky shores. The colonies are dark in colour and may be found under water or sometimes exposed at low tide. A few hydrozoan medusae and some microscopic siphonophores have been observed in the plankton. *Physalia*, one of the large siphonophores, has often been found washed ashore, and *Porpita* is frequently seen floating about as a disc with dark blue-green marginal tentacles. Two other siphonophores, *Diphyes* and *Monophyes*, have been collected in very large numbers, only once, during May 1946, in Kamat's Bay. The whole beach was glistening with the beautiful floats of these forms.

SCYPHOZOA:

Two common jelly-fishes known in Karwar are *Dactylometra* and *Acromitus*. *Dactylometra* is the larger of the two types, where the umbrella is comparatively flat and the surface coarse to the touch. The lips are produced into long delicate arms. *Acromitus* has a dome-shaped umbrella with a smooth outer surface which appears finely granular when magnified. The lips are divided into eight short thick arms, each produced into a long thread-like filament. In certain seasons, generally during the cold weather, these jelly-fishes appear in shoals and are found washed ashore in enormous numbers.

ANTHOZOA:

Among the Anthozoa, sea-anemones and *Cavernularia* are the only forms best represented in Karwar. Corals are almost absent and none have been recorded in the living condition so far, but dead and worn out pieces of the coral, *Goniastraea*, have been collected sometimes. Fragments of *Gorgonia* have also been collected occasionally on the shore. Sea-anemones have been recorded in a variety of places, on free surface of rocks, in the holes and crevices of rocks, buried in sand, in rock-pools and attached to molluscan shells either empty or occupied by hermit-crabs. The sea-anemones occurring in these habitats are described as follows:

Actinidae: *Anemonia* is fairly common in the intertidal zone, generally on bare surfaces or crevices of rocks. The margin of the discs bears a number of irregularly arranged knobs and numerous tentacles. The animals are usually red in colour, sometimes purple, and the tentacles are darker or even deep violet with light-coloured tips.

Bunodactis has a number of species very variable in its characters, but all have longitudinal lines of warts on the column. The species found in Karwar are about 1½ inches in length and are attached to rocks either submerged in water or exposed only at low tide. The upper part of the column bears longitudinal rows of suckers to which are attached fragments of shells and other particles. The disc is greenish in colour and the tentacles are pale and pointed.

Sagartidae: *Sagartia* is a very common form attached to molluscan shells, empty or occupied by hermit-crabs. Many have been collected attached to empty shells of *Turritella* (*T. acutangula*) buried in the sand with only the disc exposed. When contracted, *Sagartia* looks like a small translucent onion with a few filaments projecting from the pointed end. These anemones are brownish yellow in colour with light longitudinal stripes. When fully expanded the column is about two inches in length.

Zoanthidae: *Zoanthus* is a small colonial form frequently seen in the crevices of rocks or in the rock-pools in the tidal region. Its column is long and yellowish grey in colour and the disc presents shades of brown with a variety of green marks. The tentacles are striped and are of different colours. When sand particles are strewn over the disc by the action of waves, the animal is difficult to detect.

Gemmaria is similar to *Zoanthus*, but is smaller and generally found in large numbers spreading over the rocks. When expanded, they form a conspicuous mosaic of hexagonal figures. They usually grow on horizontal and vertical surfaces of rocks. These animals are sand-encrusted and leathery to the touch. The column and the tentacles are brown and the disc is green.

Cavernularidae: *Cavernularia* is a pear-shaped colonial form and a very beautiful object to see when expanded. They stand erect in water with only the stalks buried in the sand. They have been observed in large numbers in their natural surroundings, in the creek at the mouth of the river Kalinadi. Occasionally, however, they are washed on the beach in a contracted condition, when they look like short clubs with narrow grooved handles and with brown depressions over the rest of the body, indicating the position of the contracted polyps.

CTENOPHORA:

Two representatives of Ctenophora, observed in Karwar, are *Pleurobrachia* and *Beroe*. *Pleurobrachia* has been collected in large numbers, washed ashore on the beaches and looking like small blobs of jelly. *Beroe* has also been collected occasionally on the shore and sometimes in the plankton.

PLATYHELMINTHES

The common marine flat-worms are the planarians, found crawling on the rocks, sea-weeds and among the bivalve molluscs. Some have colours merging with the background, sometimes brown and grey, and are often inconspicuous, while others are brilliantly coloured. The planarians of Karwar have not been identified.

NEMERTEA

The Nemertine worms, collected from Kamat's Bay, were found on the rocks among the attached animals and sea-weeds. Only two forms are known. *Eupolia* is a slender brownish red worm with a dark streak on the middle of the back. It was about ten inches in length when expanded. Another worm about twenty inches long was collected from the same locality. It was violet in colour with regular, narrow, circular white bands at intervals. It resembled *Tubulanus* (*Carinella,* McIntosh), recorded in the British Isles.

ANNELIDA

The free-living Polychaets are represented by a number of Nereid worms collected from sea-weeds, among encrusting animals on rocks, and various other habitats. *Polynoe* is commonly found on the underside of the rocks on all rocky shores. Post-larval Polychaets have also been collected from the plankton. The tubicolous Polychaets are represented by the following four forms :

Polycirrus and *Terebella* are recognised by their numerous long, orange-red, brightly coloured, sticky tentacles. They have been collected from the empty oyster shells encrusted on the loose rocks in the muddy areas of Kadra and Chendie Creek.

Owenia is found in large numbers in Kamat's Bay. They live in sandy tubes which are so closely packed together, that they give the appearance of coral-like encrustations, extending over a large area in the inter-tidal zone. The mouth of the worm is surrounded by a membrane which has marginal filaments.

Spirorbis lives in small calcareous tubes found as encrustations on the sea-weeds. They occur in large numbers all over the coast.

Sternaspis is a representative of the burrowing Polychaets and has been collected by dredging in Karwar Bay. It possesses a short body with a thickened anterior region, carrying on each side three rows of setae. On the ventral side of the posterior end of the body, there is a bilobed horny plate with a number of bundles of long setae. The anus is situated on the dorsal side with two bundles of filamentous branchiae on either side of it.

Dendrostoma is the only Sipunculid represented and is found burrowing into the sponges encrusting the rocks. It is shaped like a base-ball bat, the handle being the neck which is protrusible through a circlet of branching tentacles. Usually it is about four inches in length.

ARTHROPODA

CRUSTACEA :

The Crustaceans, which form the bulk of the marine Arthropods, are found almost everywhere in Karwar. It is difficult to avoid seeing or coming across a crab in any locality of Karwar. Large numbers of Dhobi-crabs waving their coloured chelae can be seen in a number of places. Hermit-crabs inside empty molluscan shells are found everywhere near the shore. The plankton teems with a large variety of minute crustaceans and their larvae. The following are some of the common crustaceans recorded:

COPEPODA : A large number of Copepods are found in the surface waters and have been collected in the plankton. *Calanus* is the most common and is cosmopolitan in distribution. It is recognised by its iridescent plumed hairs borne on different parts of the body, the long antennae and the single egg-sac. There are also many forms of copepods parasitic on the body of fishes.

CIRRIPEDIA: Acorn-barnacles are by far the commonest. They are found in vast numbers attached to rocks, to wood and to molluscan shells. The following two species are met with in large numbers:

Balanus tintinabulum (Linnaeus) is a large barnacle with purple coloured plates and is found on rocks which are always very near the water.

Balanus amphitrite (Darwin) is a small and lighter coloured animal, found in thousands encrusting the rocks in or near the water. They are found so crowded together that they almost look like sheets covering the rocks.

A point to be noted regarding the feeding habits of these barnacles is that they are dependent on the place of their attachment. Thus, those that are permanently submerged can feed at all times; those living between tide marks obtain their food only twice a day during high tides; and lastly those that live beyond the high tide level get only what little food is provided by the spray that comes their way.

Goose-barnacles are not very common in Karwar. Only two forms have been collected.

Lepas, attached to floating pieces of wood and cuttle-bones, has been occasionally found washed ashore.

Ibla quadrivalvis (?) is found in small groups attached to stones in Kamat's Bay. It is easily distinguished in having only two terga and two scuta, and the animal is completely covered by soft brown spines pointed posteriorly. This species is interesting in that, though its presence in the Indian Ocean has been recorded, the exact locality where it occurs seems not to have been known so far.

Sacculina is the parasitic cirripedia observed on the crab (*Neptunus*), which have been collected from the rampan nets.

ISOPODA: As elsewhere, the Isopods are quite abundant in practically all littoral regions of Karwar. The majority of them are small and many are coloured like their surroundings. Those found among the sea-weeds have almost the same colour as the sea-weeds, red, green or brown. Those living among the rocks are slate-coloured, e.g. *Ligia*. *Ligia exotica* (Roux) is found in large numbers on boats, on logs of wood near water, and along the rocks and stones of the shore. They are semi-terrestrial, living near the water, and would be drowned if submerged for sometime.

Cymothoa has been observed living parasitically in the mouth of Pomfrets (*Stromateus*). It is possible that more isopod parasites would come to light if further search is made, in view of the fact that Karwar has such a rich variety of fishes.

AMPHIPODA: Amphipods are also quite abundant in the littoral regions. *Stenothoe* is a very common sand-hopper, living on sand or on decaying sea-weeds, easily recognised by its jumping movements. Another odd-looking amphipod, seen crawling over the hydroids or algae, is a Caprellid. They move about like a caterpillar with looping movements and their colouration is similar to that of the surroundings.

STOMATOPODA: *Squilla* is the only Stomatopod collected at Karwar. They are seldom found with the objects washed up on the shore, but are brought in by fishermen in their nets and are discarded as they are inedible. They need to be handled with care because they can inflict injuries with their tails and maxillepedes. *Alima,* the larva of *Squilla*, has often been observed in the plankton. It is recognised by its great size (about 3 cms. in length), glass-like transparent body, long, broad carapace, unlike that of the adult, and and a pair of prominent stalked eyes.

DECAPODA: The first large living animals that one frequently meets on the shores of Karwar, are the Decapods, be it a prawn, swimming in the shore waters, or a crab, running about on the beach, or a hermit-crab, strutting about with a molluscan shell.

MACRURA:

Penaeus is the common edible prawn that is sold in the market, either in fresh condition or dried. They can be recognised by their serrated rostrum and chelate legs. They are usually brought to the shore by the fishermen in their nets.

Lucifer, with its elongated body, slender limbs and long eye-stalks, is a luminiscent form usually found in the plankton.

Alphaeus is found in the crevices of rocks. Its first thoracic leg, either the right or the left (never both), is very much enlarged. They make a peculiar noise by means of these appendages.

Hippolysmata, possessing a large rostrum and prominent eyes, is usually found in rock-pools and on sea-weeds.

Panulirus is the 'painted spiny lobster' living on the rocks, whose skeleton is often washed ashore.

ANOMURA:

Hermit-crabs, living in empty molluscan shells, are found in large numbers on the shores and also in the rock-pools. A majority of the Karwar forms belong to two genera: *Diogenes* and *Pagurus,* which are recognised by their unequal chelae. Those living in water often carry sessile animals like *Sertularia, Sagartia,* or *Balanus amphitrite,* on their backs.

Porcellana is usually found living under encrusting sponges, ascidians and hydroids. Their abdomen is symmetrical and flexed beneath the thorax and bears a well-developed telson. In the plankton, the peculiar Zoea larva of *Porcellana* is observed quite frequently and is readily recognised by the enormously long rostrum and posterior spines.

Emerita asiatica (Milne-Edwards), the mole-crab has an oval body about one inch in diameter and is pinkish in colour. They are very abundant occurring on open sandy beaches between tide marks. As the waves beat shoreward, they emerge from the sand and are carried higher up the shore along with the water, thus exposed to view for a brief period, and when the waves recede they rapidly burrow into the sand and wait for the next wave to repeat the process. During low tide, when they are stranded on the shore, they burrow deep into the sand and reappear at the next high tide.

Albunea symnista (Linnaeus) is another mole-crab, stouter than *Emerita*, and lives buried in the sand below the low tide level, but is sometimes brought to the shore entangled in fishermen's nets. Very few of them have been collected.

BRACHYURA:

Crabs form a characteristic group of the fauna of Karwar. They are found in very large numbers, in a variety of habitats all along the coast. Only those actually found on the shore, or those living in areas adjoining the shore, have been described here. Other crabs living beyond the littoral zone are known only by their remains that are washed ashore from time to time. Crabs belonging to the following six families have been recorded.

Calappidae:

Calappa lophos (Herbst) and *Matuta victor* (Fabricius) are represented here, and of these the former is rare and the latter more numerous.

Calappa lophos has a large arched, semicircular box-like carapace and the crested chelae are massive and fringed with hairs.

Matuta victor has a rounded carapace with a single stout triangular spine projecting on each side. The two chelate arms are large and the four pairs of legs are broad and flat and are used as paddles when swimming. It is much more active than *Calappa*, but usually spends much of its time buried in sand between the tide marks.

Leucosiidae:

Philyra scabriuscula (Fabricius) is the most common species and is found in large numbers on the sandy beaches between tide marks in Kamat's and Binge Bays. They are small lightly coloured crabs, more or less globular in shape, with long slender legs. They are usually seen hurriedly burying themselves into sand as the waves retreat.

Portunidae:

These are swimming crabs with only the last pair of legs paddle-like, the first three pairs being adapted for walking. The carapace is depressed with distinct characteristic teeth on the antero-lateral margins. The following three are the most common genera: *Neptunus, Charybdis* and *Thalamita*. These are the common edible crabs sold in the market and are collected from fishermen's nets.

Neptunus is recognised by the antero-lateral margin of the carapace bearing nine teeth and a long spine projecting sidewards. Two species have been collected: *Neptunus pelagicus* (Linnaeus) and *N. sanguinolentus* (Herbst). In the former, the carapace has a network of coloured markings and the back margin of each of the chelae bears a terminal spine. It is commonly seen swimming rapidly in the shallow waters of the creeks, with one chela stretched and trailing behind, and then often mistaken for a fish. In *N. sanguinolentus*, the carapace is uniformly coloured with three large red spots on it, and the back margin of the chelae is without teeth.

Charybdis has the antero-lateral margin of the carapace with six teeth and is collected in good numbers from the nets. In one species, *C. crucnera,* the design on the carapace looks like two angels on either side of a distinct cross and it is therefore held in reverence by some Christians.

Thalamita has five teeth along the antero-lateral border and the eyes are widely separated. It is usually found in the creeks.

Xanthidae:

Xantho and *Atergatis* are the two forms found on rocky shores between tide marks. The antero-lateral borders of the carapace are thick and blunt. *Xantho* is small with heavy chelae and the surface of its carapace is furrowed. *Atergatis* is bigger and oval in shape, with the surface of the carapace smooth and pink coloured with small white spots all over.

Grapsidae:

Grapsus strigosus (Herbst) is the common form found in large numbers on the rocky shores, seen either in or out of water. They are very active crabs with a medium sized, roughly hexagonal, flattened carapace, which is green in colour and shows dark stripes directed towards the posterior median line.

Ocypodidae:

The members of this family are very prolific on the shores and the creeks. The carapace is more or less convex, eye-stalks greatly developed, and the legs have pointed ends. They are active creatures living in deep burrows on the sandy shores. This family is represented by the following three genera: *Ocypoda, Dotilla* and *Gelasimus.*

Ocypoda is a familiar genus living in burrows in the sand near or above the high tide mark. They are flesh coloured, with the eye-stalks extending beyond the corneal surface. They run fast on the tips of their legs, keeping the body well raised above the ground. When chased they retreat into their burrows or escape into the sea. They can be seen in large numbers at night.

Dotilla are found moving about in groups of thousands in the Chendie Creek. They are small in size with globose bodies, living in sand or mud only below the high tide level, usually in the backwaters, but never on steep beaches. Their appendages are slender and pink coloured, and the body is dark.

Gelasimus or the 'dhobi-crab' is more common than *Dotilla* and is found in very large numbers on sand or mud banks of Chendie Creek and Kalindi estuary, usually along with *Dotilla.* The males are characterised by having one chela very large and brilliantly coloured, and they have a peculiar habit of constantly waving this chela (like a dhobi beating clothes on a stone, hence the name), sitting at the mouth of its hole, presumably to attract the mate. Extensive areas of mud banks with thousands of waving chelae of these crabs is a very impressive sight in Karwar.

ARACHNIDA:

The only marine arachnid observed is a pycnogonid occurring in Kamat's Bay. These 'no-body-crabs' are generally found crawling among the hydroids, sea-weeds and polyzoans.

INSECTA:

Strangely enough there is only one true marine insect, which is found in the sea far from the shore. It is the wingless bug, *Halobates*, whose eggs in various stages of development are often found on the cuttle-bones washed ashore.

Cicendela is a beetle, that is found on the shore among decaying weeds, and is recognised by the way it takes to wing when a wave rushes up, and settles on the sand as soon as the water recedes. *Dermestes vulpinus* is another beetle found in large numbers infesting the fish that is being cured.

A species of *Musca* is found in thousands in the fish-curing yards during the mackerel season. There is also a species of *Tabanus*, a few specimens of which have been collected in Kamat's Bay.

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ON AN INTERESTING CASE OF CARP SPAWNING IN THE RIVER CAUVERY AT BHAVANI DURING JUNE, 1947*

BY

S. V. GANAPATI, K. H. ALIKUNHI AND FRANCESCA THIVY

(*Freshwater Biological Research Station, Government Fisheries, Madras*)

INTRODUCTION

The fluviatile species of Indian carps generally breed during the monsoons, June to August and November to December. Hora (1945) reviewing our knowledge of the breeding conditions of Indian carps concludes that 'a heavy monsoon flood is the primary factor that influences the spawning of Indian carps and that the other topographical, chemical and physical changes in the environment of the fish are entirely dependent on it'. He further states that there is 'a consensus of opinion that the flooded condition of a river or a tank is the primary factor that is responsible for the spawning of Indian carps'. Mookerjee (1945), on the other hand, considers dissolved oxygen as a factor of primary importance in inducing spawning of fish. According to him 'practically no freshwater fish spawns without some amount of rain water mixed with the old water of the pond', and 'for major carps almost pure rain water is needed' for spawning. But in a previous contribution Ganapati and Alikunhi (1950) have endeavoured to show that spawning mainly depended on the availability of suitable shallow spawning grounds and have pointed out how Hamid Khan's observations (1947) also support the same view, although the latter arrives at a different conclusion. In the present paper a peculiar instance of carp spawning in the river Cauvery at Bhavani in South India, is described which further supports the view that while neither rain water nor turbid flood water is essential for spawning, the availability of suitable spawning grounds appears to be the deciding factor to induce spawning.

PRE-SPAWNING CONDITIONS

The south-west monsoon was practically a failure in Madras during 1947 and water level in the Stanley Reservoir, Mettur Dam, was therefore very low. There was no rain in the Mettur-Bhavani area during June. The water in the reservoir was very clear and not muddy-brown, since rains were scanty in the upper reaches also. The level of water in the reservoir was maintained at the surplus level only from the 1st to the 20th June, when the surplus channel ceased to function. The level of water in the river below the dam, consequently, was very low resulting in portions of the river-bed being exposed and dry. When the surplus channel was not functioning, limited quantities of water were

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being sent out through the sluices, for irrigation purposes and this, besides maintaining a continuous flow of water in the stretches of the river Cauvery immediately below the dam, had resulted in the re-inundation of the shallow portions of the river-bed which had previously become exposed when the surplus channel ceased to function. Owing to the failure of monsoon rains, almost summer conditions thus prevailed in the river and the water was very clear with a bluish tinge.

SPAWNING IN THE RIVER

From 23rd June 1947 onwards the River Survey Staff at Bhavani were obtaining a few eggs, almost daily, in the spawn nets fixed in the river proper, at Bhavani. The time of collection varied from 6 p.m. to 8 a.m., but the eggs were collected usually in the morning for a few hours only. These contained mostly catfish eggs; and the local staff had not made any systematic attempt to ascertain when the eggs began to appear in the nets daily and whether carp eggs were also available in the river at any other time of the day.

Detailed observations were carried out on 28th and 29th June 1947. Samples of water were collected for analysis at four-hourly intervals and by 6 p.m. spawn nets were fixed at a selected spot about a furlong below the bridge and close to Kumaramangalam on the left bank of the river near the marginal zone where the depth of water was only about 2·0 to 2·5 feet, and where there was fairly rapid flow of water from the main current. The nets were examined at hourly intervals but till 11 p.m. no spawn was collected in them. From 12 p.m. (mid-night) onwards carp eggs began to be caught in the nets in large numbers. The physico-chemical conditions of water prior to and during collection of spawn were as shown on page 142.

The water was flowing at a velocity of about 5 miles per hour. Phytoplankton was fairly rich and representative, and consisted of Myxophyceae (*Merismopedium*, *Microcystis*, *Oscillatoria*, *Anabaena* and *Anabaenopsis*), Chlorophyceae (*Scenedesumus* and *Mougeotia*), Bacillariae (*Synedra* and *Navicula*), Dinophyceae (*Peridinium* and *Glenodinium*), and Euglenophyceae (*Euglena*). Zooplankton was poor and consisted of stray specimens of copepods (*Cyclops* and *Diaptomus*) only.

During the period of about 22 hours there had been no appreciable change in the physico-chemical variables of the river water. While neither the actual spawning ground nor the process of spawning was observed, the fact that there was no appreciable change in the physico-chemical conditions immediately prior to and immediately after spawning probably shows, that the spawning conditions were not widely different.

NATURE OF THE SPAWN COLLECTED

The mid-night collection contained fertilized, developing eggs, in advanced stages of segmentation. All the eggs were more or less in the same stage of development—the blastoderm cells about to commence invasion of the yolk. The eggs were almost transparent, with spacious perivitelline area. The diameter ranged from 2.8 mm. to 4.0 mm. There were no catfish eggs. Three distinct sizes could be distinguished in this collection of eggs. These were isolated and kept for rearing

TABLE I

Physico-chemical conditions of water in the River Cauvery, at Bhavani on 28th and 29th June 1947, when carp spawn was collected.

Date	Pre-spawning 28-6-'47				During (?) and immediately after spawning 29-6-'47								Remarks
	6 p.m.		10 p.m.		12 Midnight		4 a.m.		6 a.m.		10 a m.		
	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	
Meteorology ...	No moonlight—No rains				Moon-light — No rains								
Colour ...	Bluish-green				← Bluish-green →								
Turbidity ...	>30 cms.				← >30 cms. →								
Depth at collection spot. ...	2·0—2·5 ft.				← 2·0—2·5 →								
Temp. (°C) ...	29·4	29·3	29·3	29·3	28·8	28·8	28·3	28·3	28·2	28·2	28·8	28·7	
Free CO_2 ...	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	Nil.	
CO_3* ...	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	0·3	
HCO_3* ...	18·147	18·300	17·995	17·995	17·995	17·690	17·690	17·995	18·300	18·300	17·690	17·690	
pH. ...	8·7	8·6	8·6	8·6	8·5	8·5	8·5	8·5	8·5	8·5	8·5	8·5	
D.O. (cc./L.) ...	5·165	5·305	4·886	4·886	4·746	4·746	4·746	4·746	4·886	4·886	5·016	4·956	
% Sat. ...	92·9	94·2	86·7	86·7	83·6	83·6	82·9	82·9	85·2	85·2	88·3	88·3	
Chlorides* ...	1·7	1·7	1·7	1·7	1·7	1·7	1·7	1·7	1·7	1·7	1·7	1·7	
P_2O_5 ...	+	+	+	+	+	+	+	+	+	+	+	+	
NO_5 N ...	+	+	+	+	+	+	+	+	+	+	+	+	

*Results expressed in parts per 100,000.

for purposes of identification. The nets were thereafter cleared at hourly intervals. Collections continued to be heavy, but eggs in advanced stages of cleavage were not available. Embryonic development had progressed in the meantime and as the day advanced only eggs with well differentiated embryos, executing movement inside, could be procured. These later collections contained about 10% of catfish eggs which were easily distinguished by their greater opacity and the conspicuous zona radiata forming a thick membrane outside the vitelline membrane. By about 8 a.m. carp eggs were not available in the river and the net collections contained only few catfish eggs with fairly advanced embryos.

The collections were repeated on 30-6-47 (night) also, but were not as heavy as on the previous night.

The different types of eggs were carefully described and reared in the laboratory. Samples were transported to Madras and after successful rearing for about three weeks, were identified. The largest eggs, about 4.0 mm. in diameter, were those of *Labeo fimbriatus* (15%), the medium sized eggs (about 3.4 mm. in diameter) were those of *Cirrhina reba* (60%) and the third type, the smallest (diameter, 2.8 mm. to 3.0 mm.) were those of *Garra mullya* (25%). Details of the embryonic and larval development of these species are described by Alikunhi and Rao (1951). The catfish eggs could not be reared to the stage at which they could be identified for species.

DISCUSSION

Upto 3–6–1947 carps had been spawning in the Cauvery, every day, continuously for over a week. On 29–6–'47 when a thorough study was made and collections were taken during the night, large number of eggs could be obtained. Spawning on the 30th also was fairly heavy. While, on the previous days, no attempt was made to collect spawn either during the night or in the early morning hours, the collection of only limited number of catfish eggs after 6 a.m. does not preclude the possibility that spawning might have been more or less heavy during these days also. In all probability spawning was perhaps continuing after the 30th June also. Extended spawning has thus been taking place in the river and all these days almost summer conditions were prevailing in the locality and all along the river. No sudden fluctuations in the physico-chemical conditions of water were recorded during this period. Monsoon floods and turbid flood water that are generally associated with carp spawning were *absent* in the present instance where the river water was perfectly clear and had a bluish-green colour. As there were no rains during this period and as only stored and settled water was being discharged from the Stanley Reservoir, at Mettur Dam the river water had no admixture of fresh rain water either. In spite of these, the conditions were congenial for *L. fimbriatus*, *C. reba* and *G. mullya* for continued spawning. It is thus an instance which seeks exception to the statements that a heavy monsoon flood is the primary factor that influences spawning of Indian carps (Hora, loc. cit.) and that practically no freshwater fish spawns without the influence of some amount of rain water (Mookerjee, loc. cit.). The observations of Hamid Khan (loc. cit.) also support the above conclusion, although his own inference is that sexual play of the breeders induces spawning.

In the Batala fish farm in the Punjab he found that so long as the breeders remained confined in the tank, they did not spawn even when flood water entered the tank, but when they were given access to inundated fields they spawned. It is therefore obvious that availability of and access to shallow spawning grounds was the deciding factor that induced the fish to spawn. While the instance of spawning recorded in the present paper took place under extraordinary circumstances, it clearly shows that even when the monsoon fails, if spawning grounds are available the fish readily spawns.

While large numbers of eggs were collected, the actual spawning grounds could not be located and the process of spawning was not observed. The exact conditions of the water at the spawning ground at the time of spawning are therefore not known. However, as already indicated, the facts that the physico-chemical conditions of water in the river for over a week were more or less uniform and that the pre- and post-spawning conditions do not show any significant difference probably justify the assumption that the spawning conditions were perhaps the same as those soon after spawning, when the first collection of eggs was detected in the nets. A critical study of the physico-chemical conditions attending spawning (vide Table I) shows that factors like turbidity, flow of water, pH., dissolved oxygen, percentage of saturation of dissolved oxygen, free carbon-dioxide, etc. had not appreciably changed at the time of spawning. The dissolved oxygen and percentage of saturation during day time (10 a.m.) as also in the evening (6 p.m.) when no eggs were available, were higher than the same at 10 p.m. to 12 midnight when eggs began to appear in the nets. The view that high dissolved oxygen content which is associated with rain water is the deciding factor for inducing spawning cannot, therefore, be supported from the present observations. While the temperature of water during the day did not show any marked fluctuations, it was found that during the time of spawning (when the first lot of eggs were collected) there was a slight reduction in temperature, accompanied by homothermal conditions from top to bottom. The eggs collected at 12 midnight being 3 to 4 hours old after fertilization, the spawning time is indicated as 8 to 9 p.m. The temperature of water in the river at that time was about 0.5°C higher than that at 12 midnight. Homothermal conditions probably prevailed from 9 p.m. onwards. Other than this factor there is nothing to explain why the fish were spawning only in the night.[1] The almost routine manner in which spawning had been taking place in the river for over a week also probably indicates that no particular factor other than the diurnal fluctuations in temperature was immediately responsible for inducing them to spawn during the night. These fluctuations are, however, very slight and since major carps are known to spawn at all times of the day, some other explanation has to be sought for this continued spawning during nights only. Of course, the re-inundation of shallow portions of the river-bed by water discharged from the sluices in the Mettur Dam had provided ample suitable spawning grounds in the river itself. When the surplus channel of the dam is functioning, the water level in the river will be high and naturally there will be considerable depth of water over the above mentioned shallow portions of the river bed. But as already explained, when the surplus ceased to function there was a sudden lowering of the level which exposed the shallow portions. The discharge of water from the sluices started on the 21st June and the collection of eggs from the 23rd June onwards indicates that the fish had responded quickly to the re-inundation of the shallow spawning grounds. It would thus be apparent that the availability of and access to suitable spawning grounds with shallow depth of water at the right time of maturity of the fish is the most important single factor that induces spawning of carps.

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[1] Can perhaps light intensity have any effect on actual spawning ?—Eds.

The eggs that were first caught in the nets at midnight on 28–6–'47 were only about 3 to 4 hours old after fertilisation. Assuming that as soon as laid these eggs were drifting with the current which was flowing at the rate of about 5 miles per hour, the spawning would have occurred in the river about 15 to 20 miles above the collection spot. Later collections procured only eggs in advanced stages of differentiation and according to the above assumption the eggs collected at 6 a.m. at Bhavani, being about 9 to 10 hours old after fertilization, should have been liberated at about 45 to 50 miles above the collection spot. This however, appears to be highly improbable since spawning in all probability had taken place at one or more points below the Mettur Dam only, which is about 27 miles above Bhavani.

It is therefore possible that fish began to spawn, more or less at the same time, in scattered spawning grounds within the 27 miles stretch of the river between Mettur Dam and Bhavani. Spawning might have taken place in relatively sheltered places where the current was not fast. The eggs would take a longer time to drift into the main current from such places than when they are laid in the main current itself; and hence the nearest spawning ground from the collection spot might well have been within a couple of miles distance. The eggs from the nearest spawning grounds to the collection spot got drifted and were caught first, while those from farther grounds took a longer time to be drifted into the nets and were thus in advanced stages of differentiation.

SUMMARY

1. A peculiar instance of carp spawning in the river Cauvery, within the Mettur-Bhavani stretch under almost summer conditions, is described.

2. Monsoon floods and turbid flood water generally associated with carp spawning were absent and the water was clear and bluish-green in colour.

3. The dissolved oxygen content and the percentage of saturation of dissolved oxygen in water were not higher at the time of spawning than at other times of the day.

4. Other physico-chemical factors like flow of water, pH, free carbon dioxide, carbonates, bicarbonates, etc., did not show any significant variation during pre-spawning, spawning and post-spawning periods.

5. Availability of and access to suitable shallow spawning grounds with shallow depth of water, even in the river bed itself, at the right stage of ripeness of gonads appear to be the most important factors inducing spawning.

6. Fish appear to spawn more or less at the same time, in a fairly long stretch of the river, in areas where the current is slow and from where the eggs slowly get drifted into the main current.

7. The spawn collected was reared in the laboratory and was identified as that of *Labeo fimbriatus*, a major carp of the Cauvery, *Cirrhina reba*, a minor carp extensively used for stocking purposes and *Garra mullya*. Catfish eggs collected could not be reared.

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BIRDS AND ECOLOGY

BY

M. D. LISTER

1. WHAT IS ECOLOGY?

Ecology is the study of plants and animals (in the widest sense) in relation to their surroundings. It is in the meaning to be given to the term 'surroundings' that the real extent of the subject lies. One is inclined to think of surroundings as 'just a bit of jungle', as though it were quite fixed and subject to no change; but we must think of them instead as consisting of the earth on which the jungle grows and the rocks under the earth, as well as the atmosphere whose warmness or coldness and humidity influence the type of plants growing in the jungle, if we are to understand the relationship at all. This larger conception of the surroundings is referred to as a 'habitat', and the study of the habitat is the foundation of all ecological work. The ocean is just as much a habitat for the whale, and the body of the host is just as much a habitat for the parasite, as the jungle is for a tiger or a bird.

Having determined and described the habitat, the next logical step is to catalogue exhaustively the plants and animals and other livestock to be found there. In a full ecological survey this is done by the collection of specimens, and this is the only satisfactory way in which the identity of many species can be established beyond doubt. It is, however, still possible to do useful work without the collection of specimens. The fauna and flora having been adequately catalogued the way is open for the more interesting and complex aspects of the full survey—the study of the inter-relationship of animals and plants among themselves, the effects of changes in their environment brought about by such matters as changes in the food supply, by drought, flood and disease, and so on. There are many more factors which need not be mentioned here, for there will be few amateurs who are able or qualified to carry out work of such detail and complexity in such a way as to satisfy the scientists; for true ecology is rapidly becoming a science. To investigate fully the structure of a community and the effects on that community of the many variable factors which may play upon it, needs advanced scientific training, a good deal of equipment, the co-operation of other experts, and an abundance of time and patience.

In view of the difficulties which attend a full ecological survey of any natural community, it is not surprising that a good deal of attention has been given, particularly in Europe and America, to more limited aspects of ecology. Many enquiries have now been undertaken either into one particular subject such as the habits and habitats of Antarctic whales, or the fisheries of the North Sea, or to answer some particular question such as the enquiry undertaken in the British Isles during the recent war to find out just what damage was done to crops by Wood Pigeons (*Columba palumbus*). On the medical side there are the well-known investigations of Ross into the activities and life-history of the malaria-carrying *Anopheles* mosquito, and similar investigations on the fleas carrying bubonic plague. Properly controlled enquiries into selected subjects are of the utmost importance to mankind.

It is not quite so easy to see just how investigations into the ways and habits of birds can benefit man in any material sense, but it must be remembered that this is as yet almost a virgin field which on close study may well reveal causes and effects hitherto quite unsuspected. A few years ago it was thought that the Starling (*Sturnus vulgaris*) was responsible for carrying foot and mouth disease to Great Britain from the Continent of Europe, though the general opinion today seems no longer to support this view. And birds are certainly responsible for the distribution of the seeds of many trees and plants. There are many examples of the converse, of the effect of man's activities on birds. One of the most striking and well-known is that of the Corncrake (*Crex crex*) which was common in the hayfields of England in the last century. The introduction of earlier seeding grasses for the hay and of mechanical reapers has so reduced the acreage of grassland suitable for it to nest in that this is thought to have contributed largely to the decline of the Corncrake in many parts of England to-day.

2. The Study of Habitats

There is much useful work which can be done by the amateur who has neither the qualification, nor the time, nor the inclination to join with others in a full ecological survey. In the forefront is the study of habitats.

Plant ecology got away to a much earlier start than did animal ecology, and the geographers and plant ecologists have worked out from a mass of observations the major vegetation types for most of the world. The kinds of plants and trees that will grow in any particular place depend on many physical factors, such as the suitability of the soil and the climate. Palm trees, for instance, can grow only within certain limits of heat and humidity, and where these limits are passed, either through distance from the equator, elevation or dryness of the soil, no palms are to be found. The limits of their range can therefore be plotted fairly accurately on a map.

In the delta area of Bengal are large areas of land devoted to the growing of paddy and jute, liberally interlaced with patches of mixed jungle. If the species of plants and trees to be found in these areas are compared with those growing in the Irrawaddy Delta, some 500–600 miles away, they are found to possess many common characteristics, one of the major ones being that they require a great deal of moisture. Further to the west of the Bengal delta region, where the south-west monsoon does not carry quite such a heavy rainfall, the plant associations are all of a kind requiring less moisture for their support. By careful comparison of the plant associations in different parts of India, combined with a study of the geology and soils and particularly of the climatic conditions, it has been possible to plot on maps the areas where the plant associations have enough common characteristics to be considered as belonging to one particular type of vegetation. In each of these general types certain kinds of plants and trees are found to be dominant. And in each of them will be found many different local or minor associations possessing recognisable characteristics of their own, in each of which different kinds of plants and trees may be dominant. We speak, for instance, of teak forest or a mango or palm grove, when the dominant trees are teak or mangoes or palms; but other plants and trees are nearly always to be found in the same association, though to a lesser extent than the dominant species.

In the study and analysis of the birds to be found in these minor and major plant associations or habitats there is a great deal of scope for the bird-watcher. That different associations of birds are to be found in different habitats is almost an axiom. Compare the birds to be found in an extensive bamboo brake with those of the luxuriant Bengal jungle, with its rich undergrowth, or those of a Himalayan pine or rhododendron forest, and they will be seen to be quite different. Some species, however, may occur in each and much has still to be learnt about the exact habitats in which any given species can be found and the use to which each is put.

E. M. Nicholson in 'The Art of Bird Watching' (Witherby, London, 1931) has compiled a tentative classification of the types of habitat occurring in the British Isles, and with patience and co-operation from others his method could quite well be applied to the habitats to be found in any part of the world. Broadly he divides all habitats into certain major categories, e.g. a Coastal Group, an Inland Water Group, a Mountainous and Waste Land Group, (in India this could more satisfactorily be divided into two separate groups), a Woodland Group, a Cultivation Group, and a Civilisation Group. These main groups are subdivided. The Coastal Group, for instance, is composed firstly of the different kinds of rocky beaches, secondly of the various kinds of beaches without rocks, and thirdly of miscellaneous types such as sand dunes, salt marshes and so on. Each of these minor habitats is given an index number composed of a letter referring to the class of habitat and a number referring to the specific type of habitat. The following is an extract from his Coastal Group:

Rocky beach, with precipitous chalk cliffs.	
Type: Beachy Head, Sussex	A 2
Rocky beach, with Devonian cliffs.	
Type: Baggy Point, Devon	A 5
Shingly beach, without cliffs.	
Type: Pevensey Bay, Sussex	B 2
Muddy or sandy beach, without cliffs	B 3
Sand dunes	C 1
Salt marsh.	
Type: Wells-next-the-Sea, Norfolk	C 6

In this paper I include India, Pakistan and Burma in the title 'India' for the sake of brevity; after all, birds can hardly be expected to recognise political boundaries. A larger number of major vegetational regions is represented in India than in the British Isles, and in applying Nicholson's system to Indian habitats it would probably be helpful to prefix a second index letter to signify the major vegetational region concerned.

H. G. Champion (1936) has worked out a comprehensive provisional classification of forest types occurring in India based on four temperature zones, tropical, sub-tropical, temperate and alpine, each subdivided according to moisture conditions as reflected by the relative importance of evergreen, deciduous and thorny trees. His main divisions are as follows:

Moist Tropical Forests.

Group 1. Tropical Wet Evergreen Forests.
Group 2. Tropical Semi-evergreen Forests.
Group 3. Tropical Moist Deciduous Forests.

Dry Tropical Forests.

Group 4. Tropical Dry Deciduous Forests.
Group 5. Tropical Thorn Forests.
Group 6. Tropical Dry Evergreen Forests.

Montane Sub-Tropical Forests.

Group 7. Sub-tropical Wet Hill Forests.
Group 8. Sub-tropical Pine Forests.
Group 9. Sub-tropical Dry Evergreen Forests.

(Montane) Temperate Forests.

Group 10. Wet Temperate Forests.
Group 11. Himalayan Moist Temperate Forests.
Group 12. Himalayan Dry Temperate Forests.

Alpine Forests.

Group 13. Alpine Forest.
Groups 14 and 15. Alpine Scrub.

These groups he subdivides into their various characteristic components and he also lists the subsidiary edaphic and seral types occurring in each main group. Anyone proposing to undertake any ecological work which involves jungle of any description would do well to study this paper beforehand and to decide into which category the jungle concerned falls.

Champion's classification covers only the forest types and it would be a very useful preliminary to future ecological work if an exhaustive (even if only tentative) classification could be made of all other main habitat types occurring in India, and approved by some body of standing in order to minimise the risk of confusion in later comparative work.

3. HABITAT SURVEYS

Although information is needed on all kinds of habitats, one should, in selecting a habitat for survey, choose one that can be covered adequately with the resources at one's command. A patch of jungle may appeal as containing more kinds of birds than are found among paddy-fields, and therefore being on the face of it more interesting, but it is infinitely more difficult to survey it adequately. Until one has worked out one's own technique on easier habitats it is wiser not to attempt a comprehensive survey of so difficult a subject as jungle or scrub if one is aiming at detail and accuracy, as the results will probably be neither accurate nor complete and may well be misleading.

It is advisable to select a habitat that is characteristic of other districts as well, so that it may be used for comparative work later on, though surveys of isolated and non-recurring habitats are still valuable in view of the paucity of records so far collected, particularly if it is one which is likely to disappear eventually. Another point to bear in mind is that what are natural boundaries to us may well be 'highways' or gathering points for the birds we wish to study. A hedge or a continuous line of bushes may be a serious obstacle for man (and therefore a convenient boundary to his activities) unless there are gaps through which he can pass, but it is likely to be the headquarters of many birds.

The type of habitat to survey must inevitably depend to a great extent on one's resources and qualifications and objects. If one is working with other specialists as a team with the object of undertaking an intensive and exact study of the structure of a community, one must of necessity choose a somewhat limited area. On the other hand, if one is working entirely alone and one's opportunities for field work are restricted or irregular, it is probably wise to limit one's object to compiling a comprehensive list of all the birds seen in the district. In this case a larger area can be covered, but one should be prepared to sub-divide it into its component minor habitats and to try to disentangle the real use to which each one is put by the birds seen there. If one moves about the country from time to time similar methods can be applied to each place visited and interesting comparisons can later be made between the various habitats covered. It is useful when doing this to work out a formula or 'pro-forma' for the form and order in which one's reports are to be couched, as this facilitates comparisons later on.

In carrying out a general survey of a larger area it will probably be found that it comprises certain minor features which cannot easily be separated as distinct habitats and these can be treated as part of the surroundings in which they stand, provided that this is made clear in one's records. In Bengal, for instance, the villages are liberally prinkled with tanks, which are the resort of kingfishers, pond herons and so on; the tanks are the chief attraction to these birds, though in their comings and goings they use the surrounding habitat in which the tanks stand, and many of the other birds living in the neighbourhood go to the tanks to drink and bathe. These tanks are so numerous and so small that it is very difficult to separate them satisfactorily from the surrounding habitat.

In studying any particular habitat the first thing to be done is to describe it fully and accurately, and in this it is a great advantage if the help of a competent botanist can be enlisted to describe the vegetation, an entomologist to deal with the insects, and of other specialists to cover such matters as the local climatic conditions, the fauna, and the soil and geology. A team of observers, each one competent in his own particular field, is ideal for any habitat survey, and the combined knowledge of such observers as are available may be sufficient to bridge the gap left by the absence of, say, a geologist. Even so, a lot of useful work can be done by one man working on his own, provided he is observant, accurate and knows his own limitations.

Many features in any habitat change during the course of a year and full records should, of course, be kept of these as they may well affect the bird life. Plants come into flower and fruit, the leaves of some of them fall leaving the branches bare and a carpet of dead leaves on the ground beneath, which provides cover for insects; paddy is planted, flooded and harvested and all these changes may in some way or another influence the use to which the birds put the jungle or the paddy-fields. The metereological records should include temperatures, rainfall, humidity, wind, cloud and so on in order to provide a comprehensive record of the weather experienced during the survey period. Some animals are known to be seen more often in a dry season, some plants thrive and fruit better in a wet one, but we know little of the limits within which dryness and wetness are effective.

The natural complement to a full description of the survey area is a map or plan of it. More often than not it is necessary to prepare one's own sketch plan and this should be large enough to show all the important features clearly. If the survey area comprises more than one kind of minor habitat, these should be shown on the plan by means of different kinds of shading or hatching, or better still by the use of different coloured inks. The writer has found it very useful to give each prominent feature an identity number or letter. In studying a group of six fields, for instance, each field will be given a number, and the corners and centre points of each will be given a letter. This is much simpler than having to refer to 'the middle field on the eastern side of the area'; and it is easier and shorter to refer to 'Point A', or merely to 'A' rather than 'the south western corner of the north eastern field'. One can use one's time in the field more profitably in observing than in repeatedly writing down long terms which are constantly recurring, and provided one's records are accurate it does not matter how abbreviated a code one uses. In surveying small areas, where the number of species likely to be met with is not large, it is also useful to make a list of all the species one may reasonably expect to see there and to give each one a code number or letter. The key to this, with a small copy of the sketch plan, should be written down at one end of the field note book, so that one always has it with one for reference. It is surprising how quickly one evolves one's own code and learns it by heart.

Before embarking on any survey it is a good plan to formulate certain guiding 'rules'. Are you, for instance, going to include birds seen only flying over, and if so how are you going to refer to them in your notes and in your final report? How do you propose to deal with mixed hunting parties, which are only passing casually through the survey area? Are you going to attempt periodic counts of numbers? If so, they will require a special set of rules of their own. The making of censuses is outside the scope of this paper and anyone interested is advised to look up the reports of past censuses. Decide on these points before starting on the actual survey, so that your records may be consistent throughout.

Having selected the survey area, made a sketch plan of it, and written down a full description of the habitat, one can then begin a survey of the birds. If one is aiming at great exactitude and a detailed result, the area should be inspected at frequent intervals preferably every day, and as far as possible one's visits should take place at the same time or times each day. This is not always possible, nor is it always essential if one is aiming only at a more general result. A small note-book should always be carried in the field and the observations entered in this during or immediately after the visit to the survey area; memory dulls one's observations very quickly and accuracy may often be lost in a matter of an hour.

Some years ago the writer carried out a survey of the birds on a farm in southern England through which he passed nearly every day on his way to and from the office; this survey lasted about six years. It was by no means an ideal survey as it had to be moulded to fit the conditions under which it was made. The method adopted was to give each field an identity number, and each prominent feature (including the centre point of each field) was allotted a code letter. Another series of code letters and numbers was used for the kinds of birds usually seen. The use of these codes very quickly became automatic and the saving in time and space was enormous. Having noted in the field note-book the date and hour of the visit, any agricultural operations which were taking place, the weather and any special incidental items, a short record was made of each species seen, its numbers wherever possible, and where seen. In the case of small birds, such as larks, it was quite impossible to estimate their numbers during the 10–15 minutes in the survey area, which was usually all that could be spared, and comments had to be in such general terms as 'a few', 'several', 'a flock of about 20 in Field I and a few in III', and so on. In the case of larger birds, such as Rooks (*Corvus frugilegus*), and Lapwings (*Vanellus vanellus*), an attempt was always made to count them, or at any rate to estimate their actual numbers, and it was surprising how quickly one learnt to give an estimate within about 5 per cent of the correct number. At the end of the survey, the records were analysed in an attempt to show the use made by the birds of each kind of cultivation, as well as the seasonal fluctuations. For the larger birds graphs were drawn for each species, based on the largest number seen each week, and these suggested an interesting annual rhythm in the numbers.

It is not always possible to carry out such an intensive survey as this and one must work out one's own technique to suit the circumstances. The habitat in the survey mentioned above was a simple one, consisting only of arable and pasture land covering about 150 acres, without the complication of any woodland. While serving in India during the recent war, when opportunities of bird watching and of writing up records were very irregular the writer adopted a different technique; this has already been shortly described in his paper on 'Some Bird Associations of Bengal'.

Whatever method be used for keeping records of the survey, it is important to evaluate one's observations in order to avoid giving a distorted impression to others. If one is not absolutely certain of the identity of a bird seen it is essential that this be made clear in the records. There are many occasions on which even the most experienced ornithologist is not absolutely certain beyond all doubt of the identity of the bird he has seen, and there is nothing to be ashamed of in confessing one's uncertainty. Here again the use of signs and symbols can save a lot of time and trouble. For example, a tick can be used for a bird of whose identity one is positive; a star for one whose identity is uncertain; a cross for a 'possible' and so on. The same rule applies in recording plants and trees, animals and insects.

The records should always include a note of the time and conditions under which they were made, and of all incidental matters which might affect either the birds themselves or the validity of the record. Observations with the naked eye from a moving train or car are obviously more open to mistake and inexactitude than observations made with field glasses at only a few yards range. And the fact that aircraft are constantly taking off and landing at an aerodrome while observations are being made there may well affect the numbers and kinds of birds seen.

Although bird ringing was designed primarily to assist the study of migration, coloured rings can be a great help in studying a very small area. The British Trust for Ornithology (91 Banbury Road, Oxford, England) has published a very useful Field Guide (No. 1) on 'Trapping Methods for Bird Ringers' by P. A. D. Hollom[1], and this is well worth consulting by anyone who proposes to use ringing as an aid to a survey.

4. OTHER SURVEYS

Another method which can give useful results if properly organised and controlled, where a continuous survey is not possible, is the taking of thorough samples at longer intervals. The margin of error is, however, inclined to be greater than in a 'running survey' and there is a danger of missing trends.

Yet another method that can be usefully employed in habitat surveys is the transect. This is a detailed record of all birds seen on, say, a long train journey, or a voyage by boat up a river, or a long trek on foot. In each case, of course, an exact note is made of the habitat through which one happens to be passing at the time each bird is seen. Transect reports might have a good deal of value if there were a large number of them covering the same route at all times of the year, but their very nature is inseparable from incompleteness and inexactitude, though observations taken on a trek on foot will naturally be fuller and more accurate than those made from a moving vehicle.

In recent years some extensive surveys have been carried out into the distribution and habitats of particular species. The Lapwing Habitat Enquiry, organised by the British Trust for Ornithology in the British Isles in 1936 and 1937, is a good example. This survey was carried out by numerous observers all over Great Britain, who recorded their observations on special forms. The results were correlated and analysed by E. M. Nicholson (1939). The study of the habitats of a particular species or group of species would be an interesting task for someone with few restrictions on time or travel, but really a survey of this kind requires the co-operation of a large number of observers in different parts of the country, especially in so large a country as India, working under some central direction. A very useful preliminary would be the cataloguing of all the different habitats occurring there.

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[1] Noticed on p. 773 of Vol. 49 (4) of the *Journal*—April 1951.—EDS.

It sometimes happens that a river changes its course or a lake dries up, uncovering 'new' land which is bare of all vegetation. A somewhat similar thing happens when a hillside is scarred by a landslide. Plant ecologists distinguish between the two cases, but there is no need to do so here. Within a short time wind-blown seeds germinate on the new earth and these quickly cover it with an open vegetation with plenty of spaces between the plants. In another season these gaps will have been closed by the growth of the plants already established and the arrival of other seedlings, and then the struggle for existence really begins. If such an area is watched year after year it will be seen that the character of the vegetation changes as the plants become more congested and new layers of humus are added from the fallen and decayed leaves. One particular plant will succeed better than the others and will tend to crowd the others out. As time goes on the small first stage plants will be succeeded by larger plants and trees and eventually the climax vegetation (usually similar to that of the surrounding country) will be reached beyond which the succession does not go. Plant ecologists call this succession of vegetation a 'sere'. As the vegetation changes so the bird associations found there will change, and a complete survey through all the stages of a succession would be a most valuable contribution to ecology.

A rather similar kind of succession can be found where virgin jungle is cleared and the ground turned over to crops; or where a town is extended outwards into what had previously been countryside. Forest fires, earthquakes, landslides, prolonged flooding, extreme drought, plagues of insects and so on can all initiate a greater or lesser vegetational succession in which the sequence of bird associations is worth studying. Change is always taking place and the record of how any particular change affects the bird population is interesting and valuable.

In Bengal and other parts of India and Burma vast areas of paddy land are flooded every year as part of the regular cultivation of the crop. Flooding on such a large scale is certain to produce reactions among the avifauna of the districts affected and also the surrounding districts, and this is a subject which would be well worth organised study. Everyone keeping accurate records for his particular district would be making a valuable preliminary contribution.

Certain trees and crops prove an attraction for some birds. When the Red Silk Cotton trees (*Bombax malabaricum*) are in bloom, numbers of birds can be seen about the large flowers. Whether they are after the nectar, the dew collected in the cup of the blossom, or the insects attracted by the nectar is not known for certain, and this is a question which photography might well be able to answer. Probably the truth lies in a combination of all three, as not all of the many species of birds seen at the flowers are habitual insect-eaters. Whatever the attraction, there is no doubt that one of the results is that the birds assist in the pollination of the flowers. Many kinds of birds are also attracted by the tapping of toddy palms, but again whether by the liquid or the insects attracted by the liquid is not certain. Probably each is an attraction to certain kinds of birds. The writer has certainly seen a Tickell's Flowerpecker (*Dicaeum erythrorhynchum*) catching the drops of liquid as they fell.

Commensalism is another allied subject that has so far received comparatively little attention. Cattle Egrets (*Bubulcus ibis*), mynas and wagtails can often be seen foraging about grazing cattle and it is known that they obtain benefit from doing so in the form of insects disturbed from the grass by the movements of the beasts. Just what benefit birds find from foraging or consorting together is less clear. What, for instance, is the underlying reason for small birds to join together in mixed hunting parties, or for Rosy Pastors (*Pastor roseus*), for instance, to join together in flocks of their own kind, outside the breeding season? Is the only reason that wagtails roost together the shortage of suitable roosting places? Why do birds nest and live in colonies like the Weaver Birds? These are all questions to which no final answer has yet been found.

5. CONCLUSION

Bird ecology is only in its infancy and there is enormous scope for experiment and research. Teams of observers, each one an expert in his own subject, are ideal for the full study of a limited area and the structure of the community inhabiting it, but a single watcher working on his own can still do a lot of useful work. The control of some central body directing the activities of numerous observers spread over the whole country is essential to the success of some kinds of investigation; in the British Isles this function is fulfilled by the British Trust for Ornithology. This central body should also act as a clearing and storage house for individual reports and records, even if they are never published, where they may be available for reference and comparison by other workers. In its present state almost any contribution to ecological knowledge is likely to be useful, provided only that it is accurate.

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SUCCESSION OF THE MANGROVE VEGETATION OF BOMBAY AND SALSETTE ISLANDS

BY

B. S. NAVALKAR

(*Department of Botany, Institute of Science, Bombay,* 1)

(*With two plates*)

INTRODUCTION

While studying the ecology of the mangrove vegetation of Bombay and Salsette Islands, it was thought that it would be interesting to study the succession of the mangroves and its governing factors. Previously Blatter (2) studied the mangroves of Bombay and its biology; Biswas (1) made a comparative study of Indian species of *Avicennia.* Similarly Cooke (3) has described some of the species in his Flora of the Presidency of Bombay. But no attempt had so far been made to trace the succession of the mangroves. Due to earlier detailed study of rocks, soil salinity, soil humidity and biotic factors of the mangroves by Navalkar & Bharucha (4), it has been possible to trace out, in the present work, the different stages of the succession.

The existing mangrove vegetation in Bombay and Salsette Islands is spread on the shores of the creeks and coast of the surrounding sea. These shores of the creeks are an alluvial deposit of recent formation, as has been previously mentioned in the earlier work (4).

THE VARIOUS STAGES OF MANGROVE VEGETATION

The succession of the mangrove vegetation is governed by four factors: (1) Disintegration of rocks, (2) Soil salinity, (3) Soil humidity and (4) Biotic factors.

Due to the biotic influence, the mangrove vegetation is fast disappearing from the coasts of these islands; plants are either cut by the inhabitants near by for fuel, or uprooted and eaten away by cattle, as fodder. In Bombay there is a constant cutting and grazing of the mangrove vegetation, so that plants like *Avicennia alba* Blume, which normally grow into trees, are never seen here except as shrubs. This intensive cutting and browsing has resulted in the almost total elimination of some of the species; *Lumnitzera racemosa* seen on the shores of Bandra in 1934, now is there no more. Another important biotic factor resulting in the gradual disappearance of this vegetation is sewage. At Worli, Dadar and Bandra near the mouths of the sewage disposal pipes even hardy species like *Avicennia alba* Blume are unable to grow, and it will be interesting to find out what exactly is the factor responsible for this.

There are about 12 mangrove species round about Bombay and Salsette. Of these only one seems to be predominant, viz. *Avicennia* *alba* Blume. Hence this mangrove association can be named as *Avicennia alba* Association, consisting of the following species:

(1) *Avicennia alba* Blume.
(2) *Avicennia officinalis* Linn.
(3) *Acanthus ilicifolius* Linn.
(4) *Aegiceras majus* Gaertn.
(5) *Bruguiera gymnorhiza* Lam.
(6) *Ceriops candolleana* Arn.
(7) *Excaecaria agallocha.* Linn.
(8) *Lumnitzera racemosa* Willd.
(9) *Kandelia rheedii* Wight. & Arn.
(10) *Rhizophora mucronata* Lam.
(11) *Sonneratia acida* Linn.
(12) *Sonneratia apetala* Ham.

First Stage.

(*a*) This association at its optimum stage of development is to be seen on the foreshores of the creeks, where the tidal water bathes the vegetation twice daily, in other words this association lies between low and high tide lines. But it is rarely that all the species mentioned above are found at a time. It is only in such far away places as Ghodbunder that there are possibilities of finding a complete association. But this, too, has in recent years been made impossible by man. Ruthless cutting has resulted in the destruction and disappearance of almost all the species except *Avicennia alba.* So that to speak of *Avicennia alba* Association today is a misnomer. It is for this reason that in the present study not much attention has been paid to other species except *Avicennia alba.*

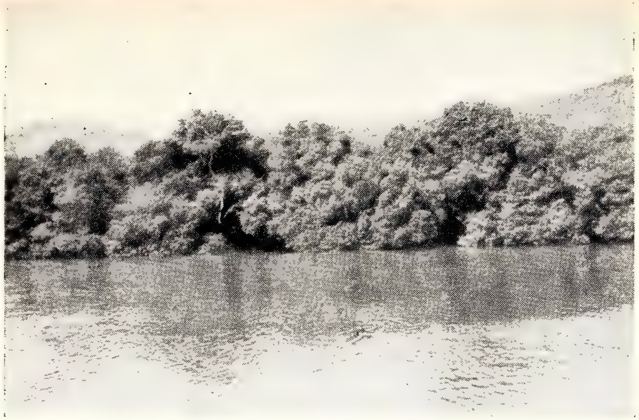
Second Stage.

(*b*) In those places where the shore is broad and extends inwards passing the high tide line, the vegetation changes with decreasing salinity of the soil. As mentioned above, due to the great influence of cutting, most of the species have disappeared from the first stage except *Avicennia alba* and *Acanthus ilicifolius.* These persist with increasing distance from the shore due to their high germination capacity and form the second stage of succession. This means that this stage of *Avicennia alba* and *Acanthus ilicifolius* is found on higher ground and in less saline soil than the main association.

(*c*) However it is found that in those areas where sweet water from rivers mingles with that of the creek, as at Mumbra, where Ulhas river flows, the main association is deflected to a stage dominated by *Ceriops candolleana* and *Acanthus ilicifolius.*

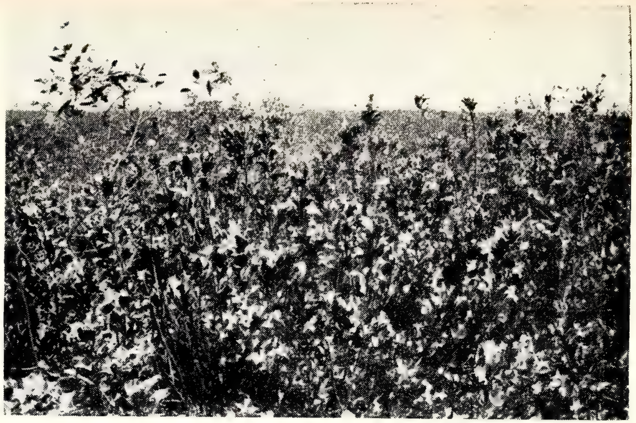
Third Stage.

(*d*) With increasing biotic factors and greater distance from the shore *Acanthus ilicifolius* disappears and the 2nd stage then turns into a pure stage of *Avicennia alba.* This is probably due to the hardiness of the plant and its higher range of adaptability, for it is found also on slightly weathered rocks at Colaba, Mahaluxmi, and Worli.



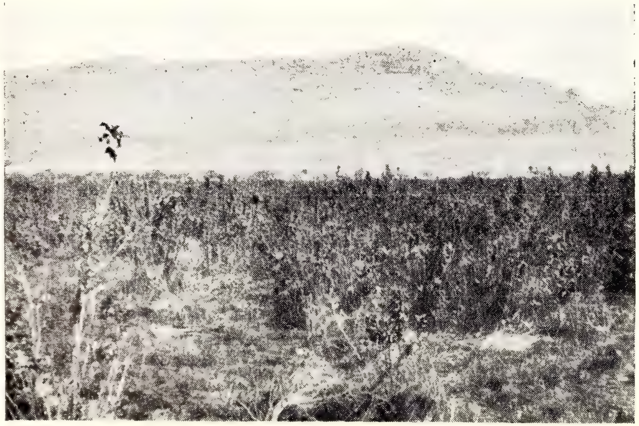
1ST STAGE.

Avicennia alba Association (optimum stage) from Uran—near Bombay.



2ND STAGE.

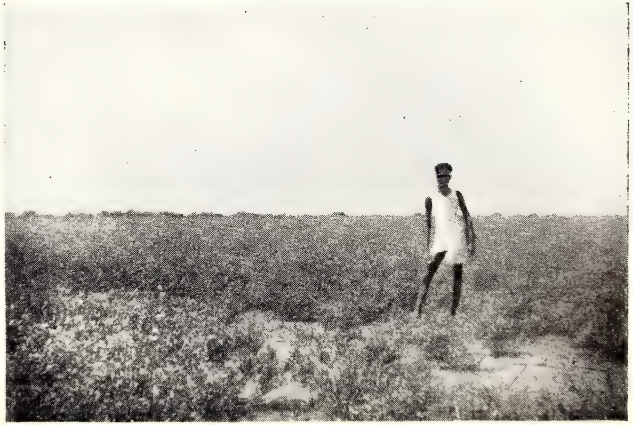
Avicennia alba and *Acanthus ilicifolius* from Bandra.



Photos

2(A) STAGE.

Ceriops candolleana and *Acanthus ilicifolius* from Mumbra.



Author

3RD STAGE.

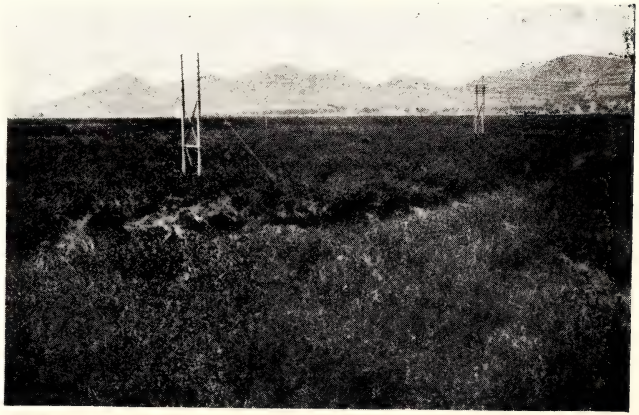
Avicennia alba from Bandra.

4TH STAGE.
Sesuvium portulacastrum from Vadala.

5TH STAGE.
Sesuvium portulacastrum and *Aeluropus repens* from Mumbra—Diwa.

Photos

6TH STAGE.
Aeluropus repens and *Paspalum vaginatum* from



Author

Clerodendron inerme from Mumbra—Diwa

Fourth Stage.

(*e*) When the distance from the shore is sufficiently big and where the tidal water bathes the soil for a short time *Acanthus ilicifolius* shows signs of disappearance and is replaced by *Sesuvium portulacastrum* Forsk. As a result one finds big patches of land covered completely by this plant at Bandra, Mahim and Vadala.

Fifth Stage.

(*f*) With increasing height and decreasing salinity above sea level, *Sesuvium portulacastrum* is invaded by the grass, *Aeluropus repens* Parl. These two form the 5th stage of succession.

Sixth Stage.

(*g*) With increase in the above two factors, *Aeluropus repens* Parl. with *Digitaria marginata* Link., *D. fimbriata* Link., *Paspalum vaginatum* Sw., *Sporobolus glaucifolius* Hochst., *S. orientalis* Knuth., *S. pallidus* Boiss., *Cyperus compressus* Linn., *C. rotundus* Linn., *Fimbristylis ferruginea* Vahl., *F. polytrichoides* Vahl., *Scirpus ferruginea* Vahl. form the halophytic pastureland.

Seventh Stage.

(*h*) Finally may be mentioned the most arid stage of succession and one which can thrive in soils with very little salinity, the *Clerodendron inerme* stage. This stage is found generally on the bunds of salt pans and includes plants like *Suaeda fruticosa* Forsk., *Arthrocnemum indicum* Moq., *Atriplex stocksii* Boiss, and *Salvadora persica* Linn. That the plants of this stage thrive well in least saline soil, is proved from the fact that *Clerodendron inerme* Gaertn. has become a hedge plant in Bombay gardens.

The succession traced above, is diagrammatically represented in the following table:

SUCCESSION OF VEGETATION IN THE MANGROVE SWAMPS OF BOMBAY AND SALSETTE

Soil	Anthropozoic influence	Stages of Succession
Blackish or grayish of clay and salt. Always inundated and swampy, lying between low and high tide marks.		1. *Avicennia alba* Association (Optimum Stage)
High level of ground with less salinity of the soil.	Cutting and burning	2. *Avicennia alba* and *Acanthus ilicifolius* Stage.
Areas where sweet water mingles with creek water.		2(*a*). *Ceriops candolleana* and *Acanthus ilicifolius* Stage.
Greater distance from shore and weathered rocks.	Increase in biotic factor	3. *Avicennia alba* Stage.
Still greater distance from the shore.		4. *Sesuvium portulacastrum* Stage.
Increase in height above the sea level and decreasing salinity.		5. *Sesuvium portulacastrum* and *Aeluropus repens* Stage.
Still increase in height above the sea level and decreasing salinity.		6. *Aeluropus repens* and *Paspalum vaginatum* Stage.
Increasing aridity and very little salinity.		7. *Clerodendron inerme* Stage.

SUMMARY

In the present study an attempt is made to trace the different stages of succession of mangrove vegetation of Bombay and Salsette islands. The mangroves are mostly dominated by *Avicennia* species. The different stages of succession are traced and it is found that the nearness of sea and consequently the salinity of the soil, together with the biotic factor, are chiefly responsible for the succession.

ACKNOWLEDGEMENTS

My sincere thanks are due to Professor F. R. Bharucha, F.N.I., D.SC., for suggesting and taking interest in the work, and to Professor S. P. Agharkar, F.N.I., for general guidance and suggestions from time to time. I have also to thank Rev. Fr. Dr. H. Santapau for correcting the paper critically and making useful suggestions.

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3. Cooke, T. (1908) : The Flora of the Presidency of Bombay.

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REVIEW

1. NATURE THROUGH THE YEAR. By Frances Pitt. Pp. 300. Macmillan & Co. Ltd., London (1950). Price 18*s*. net.

Miss Pitt's latest book appears to be a reprint of articles published week by week through the year. She gives a good picture of the course of life for birds, insects and other creatures season by season in the English Midland counties. The book is enlivened with numerous charming photographs.

Miss Pitt has an easy chatty style She wanders from one subject to another. There is no attempt to explore any matter to its roots. She is content to make her comments, often pertinent, and then to pass on to another topic. But the book is full of country lore.

It could advantageously have been more carefully edited for publication. We are told the same facts about badgers and about rats two or three times. The proper names for the male and female swan recur. There is, indeed, quite an annoying amount of vain repetition.

Another book of somewhat similar character came into my hands recently. 'The Strange World of Nature' by Bernard Gooch (Lutterworth Press, 10*s*. 6*d*.). Mr. Gooch, like Miss Pitt, finds frogs and spiders just as fascinating as tits and woodpeckers. But Mr. Gooch, without ever becoming dull or difficult to follow, penetrates much more profoundly into the mysteries of natural life. Miss Pitt, like most of us, takes her morning walk, stops for a few moments here and there, comes home again and writes her report of things seen and heard. Mr. Gooch, though he does not tell you so, has the capacity for concentrating all his faculties, hour after hour, on one seemingly trivial aspect of natural life. And what amazing discoveries he makes! Slugs, we learn from him, suspend themselves in the air on a self-produced thread of slime, in order to mate with one another. Snails shoot a cupid's dart at the intended mate. Wasps sometimes use a small stone as a tool for hammering the earth. You do not believe it? Then read Mr. Gooch's book and I think he will convince you.

Miss Pitt's book serves pleasantly enough to pass an idle hour. But Mr. Gooch leads you through magic casements into undiscovered worlds.

H.G.A.

The following books have been added to the Society's Library since April 1951:—

1. CHECK-LIST OF BIRDS OF THE WORLD. Volume VII. By James Lee Peters. (Museum of Comparative Zoology, Cambridge, 1951).

2. A DICTIONARY OF BIOLOGY. By M. Abercrombie, C. J. Hickman and M. L. Johnson. (Penguin Reference Book, 1951).

3. ANIMALS WITHOUT BACKBONES. Volumes I and II. By Ralph Buchsbaum. (A Pelican Book, 1951).

4. BEES—THEIR VISION, CHEMICAL SENSES AND LANGUAGE. By Karl von Frisch. (Cornell University Press, 1950).

MISCELLANEOUS NOTES

I. THE INDIAN WILD DOG

Notes on Lt.-Col. R. W. Burton's article published in Vol. 41 (4): 692-715.

Wild and Pariah Dogs, Page 692. I know of a case of a smallish red pariah bitch that used to play with the wild dogs whenever they came near the village cattle. Unfortunately no record of any inter-breeding was obtained.

Another black and white pariah dog from the coolie lines used to follow the wild dogs if they ran a sambar anywhere near, and used to return full fed, so the coolies used to follow it when it went for another meal, hoping to get a bit of meat themselves. When it met the pack it used to lie on the ground very apologetically and whine.

Two Species, Page 693. The Mysore shikaris (not professional) near the Western Ghats used to say there were two species, and gave the name of 'whistling dog' to the smaller one, probably because being young their call was shriller. Professor Littledale's suggestion seems correct, and the big packs were probably composed of several three-quarter grown litters. The largest dog I ever saw was a solitary, well known to the coolies who often met him hunting on his own, but it was not shot.

Pairs were also seen hunting together, and more often they were running a barking deer than a sambar. Once a big pack was apparently beating a long strip of jungle, with two or three dogs posted at each gap in the ridge on one side, at which game would be likely to break, the other side of the jungle being estate.

Colouration, Page 695. I've never seen a completely white tip to a tail on the Western Ghats, only a few white hairs; but dogs very often had a white patch with red spots on one paw.

Litters, Page 697. I once took a litter of 11 cubs from an earth. The bitch came out in a beat, and got away wounded. Beaters reported the earth, and I sat over it and shot the dog, and then dug out the litter. There was no indication of two litters in the one earth. I tried to rear the cubs, but they were very wild and died off one by one, though one survived about a year.

Voice, Page 700. I found an empty .303 cartridge used as a whistle to be the best note for calling up dogs, pressure should be decreased at the end to give a wailing note, and dogs answered it especially if they had been scattered by a shot, or driven off a kill, and it usually paid to alter position and to take good cover.

Cattle killing, Page 703. I've known several instances of full grown cattle being killed by dogs, the worst being when a pack stampeded a herd of cattle which charged into a nursey under a pandal, and five or six cattle were pulled down in the nursery, and unfortunately only one dog was shot, as the cattleman only possessed a S.B. muzzle-loader.

Attitude to Mankind, Page 706. I remember two instances of coolies being treed by dogs. Two coolies tried to drive the dogs off a kill, but the dogs came at them snarling so they climbed trees, and stayed there till the dogs fed and cleared off. Another cooly met a pack on the cart road, which did not clear off when he shouted, but came on, so he climbed a tree, and the dogs sat around under the tree for a bit looking at him.

I checked up on this by the tracks in the dust.

Wild *vs.* Domestic Dogs, Page 709. On two occasions I had my terriers chased by wild dogs, which only stopped when I rode at them shouting. Once a terrier running a line was killed and eaten, judging by the hair in the wild dog droppings. I have however seen a big solitary wild dog running from quite a small fox terrier, but the wild dog may have spotted me.

Toughness, Page 712. I confirm their toughness and vitality, and consider that proportionately they take more killing than any other animal in these parts.

YELLIKODIGI ESTATE, A. MIDDLETON
CHIKMAGALUR DISTRICT,
MYSORE STATE,
20th March, 1951.

2. A WILD DOG INCIDENT

One evening I went for a walk with our four dogs, a black cocker spaniel, two black and tan dachshunds, and a golden retriever. I emphasise the colour as it seems to have some bearing on this incident. We took a path through some thick bamboo jungle, and suddenly they all picked up the scent of something, and disappeared, barking excitedly. I had seen nothing, and thought they were on the scent of a hare as usual. I whistled, and after a few minutes the three black ones returned, tails down, and obviously very unhappy about something. They would not leave my side, and sat crouching as near me as they could get. This worried me somewhat, as the retriever was not mine. I was only looking after him while his owners were on leave in England. Moreover he was an old gentleman, nearly 11 years, and had two years previously been badly gored by a wild boar.

After about five minutes of silence, I heard him barking in the distance, and whistled to him again. This time he came, tail up, looking extremely pleased with himself. To my amazement he was leading a pack of wild red dogs, who had obviously accepted him as one of themselves. He came over to where I stood, and for a few seconds we all stood and looked at each other, the pack 15 ft. away, and our four, and myself. Then the wild ones turned and disappeared the way they came. I counted five, but there may have been more.

Another thing that impressed me was the polite manner in which they saw 'Bowler home', so to speak. He was obviously very thrilled at being accepted as 'one of the boys.' Why the other three dogs were so frightened, I cannot say. I can only assume they were the wrong colour to be recognised as the same species.

CHEMBRA PEAK ESTATE,
CHEMBRA P.O.,
VIA MEPPAD, MALABAR,
27th March, 1951.

JOYCE C. WINTERBOTHAM

3. REARING A BABY CEYLON GREY FLYING SQUIRREL (*PETAURISTA PHILIPPENSIS LANKA*)

(*With a photo*)

March 5th (1951) saw the arrival of a new and somewhat strange baby—a very young and helpless Grey Flying Suirrel of the local race *lanka*.

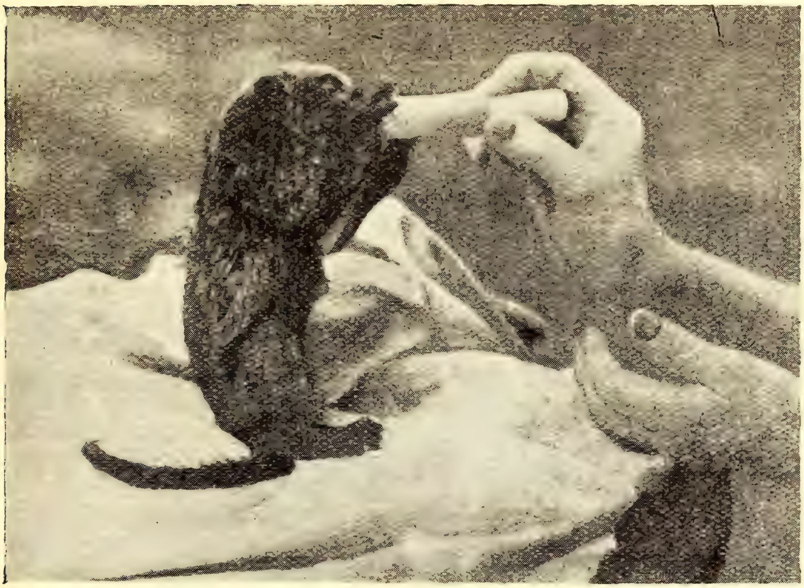
It was brought in while I was in my office, by a villager from below the estate (Galapitakande) who said that he had found it in a hole in a branch when he was cutting down a dead tree for firewood. He did not see the mother-squirrel so, presumably, she must have escaped, unseen, as soon as the cutting down started.

The baby flying squirrel was very young—probably little more than a week old—but I had no means of ascertaining his exact age. He just fitted nicely into the palm of the hand, as a warm, furry, greyish ball.

My wife took to him at once; he was so pathetically helpless, yet so attractive with his large dark eyes, and his long, black, furry tail wrapped round his little soft body. Preparations to feed and rear him were immediately made—although he looked a little young for hand rearing. A tin of Klim, another of glucose and a little calcium were produced, together with a glass tube-bottle, for use as a feeding bottle, with a piece of felt wrapped round it to form a feeding-funnel and mouth-piece. Felt appears to suit most young animals better than rubber as they can get hold of it and suck it more easily. Every two hours, throughout the day, from 6 a.m. to 10 p.m. was the routine to start with, but after a week or so longer intervals and larger feeds were given so that within ten days of his arrival he was having two teaspoons of Klim, two of glucose and a pinch of calcium at each feed, well mixed with hot water and allowed to cool off. To this was added, after the first week, a little mashed plantain, after it had been put through a sieve. When not feeding, he slept very soundly, loosely wrapped in an old, knitted, woollen shawl, in a small box-cage where he was as warm and as snug as he would have been with his own mother.

Right from the day he was brought to us he thrived on this diet, so that after three weeks or so he had more than doubled his size and was able to sit up, in a proper squirrel like attitude and grasp his feeding tube in both his little, hand-like forepaws.

Now, just two months after his arrival, he is a fine animal with a long, silky, grey coat, just the colour of Silver-fox fur, a long, bushy black tail and black limbs with little naked knuckles to his long slender forepaws. He is perfectly tame and lops along to meet his mistress, when he is out playing in the evening. No longer does he have to be hand fed; he feeds himself, selecting his food from a very mixed diet consisting of tomatoes, sweet-potatoes (yams), nuts, raisins and plantains, washed down with his usual Klim or other milk-powder, glucose and calcium from a bowl. Cow's milk he does not have as, curiously enough, cow's milk does not agree with the majority of small wild animals.



Young ♂ Ceylon Grey Flying Squirrel (***Petaurista philippensis lanka***) being fed with milk solution

Until the evening, he likes to lie sleeping in his covered-box, but as dusk falls he becomes active, if not lively, and hops around in his rather ungainly manner or climbs up anything handy—preferably cloths to a convenient shoulder. He is very gentle and confiding, but if alarmed he will grunt at the intruder in a curious Bandicoot-like manner and attempt to frighten him away. I have heard no other sound from him.

Flying squirrels of this species are to be met with in the well-wooded foothills of this neighbourhood. They are certainly not common, but being purely nocturnal they are probably more numerous than they appear. Although they are, perhaps, more plentiful in the lower foothills, they have been encountered even on the Horton Plains, at altitudes of over 7,000 feet.

TONACOMBE,
NAMUNUKULA, W. W. A. PHILLIPS
7th May, 1951.

4. GAUR ATTACKING MAN

I thought you might be interested in the following account of an attack by a bull bison on a solitary coolie which ended fatally.

Between the Anamallai Hills and the High Range Hills, at an elevation of about 6,500 feet, there is a large stretch of grassy downs with small patches of shola on them. Through this country runs a short-cut of some 20 miles occasionally used by coolies though generally only parties travel together on account of the numbers of bison and elephants which are to be found there. At the beginning of March two coolies on their way back from the High Range came upon the body of a coolie who had come over ahead of them on his own. He had apparently come upon a solitary bull bison on the path just after he had crossed a small stream (which is a popular watering place for bison) and they believed he threw stones at it, though this is not certain.

The bison anyhow charged him and gave him a good tossing, and ripped him up a bit with its horns and then after trampling on the body to make sure of its job, it left the scene.

Mr. J. S. MacPherson the Asst. Manager of Akkamallai Estate who later saw the body on the spot, wrote to me and said that the coolie's cloth was found hanging in the branches of a tree (showing how high he was tossed). The body was very badly gored. One horn had entered below the left shoulder blade and had ripped diagonally upwards passing through the spine at the base of the neck. The other major injury was an abdominal one and was even more gruesome as his stomach and intestines were tucked under his left arm. Mr. MacPherson's theory for this accident is, that the bison while coming for a drink at its watering place, finding the coolie in the way, promptly charged and killed him, probably being aggravated by the coolie throwing stones at it (though I personally think that no sensible coolie would do such a thing). If anyone shoots the bison another reason might be found such as an old wound or something.

The particular solitary bull bison who lived in this locality was well known to me and certainly on the numerous occasions I met it, it never attempted to be aggressive. The only theory (other than the one above) that I can put forward is that the bison had been mauled by a tiger and later seeing the coolie mistook him for the enemy and proceeded to get his own back.

It is of interest to add that some two weeks before the above incident I shot a bull bison about 2 miles away from the scene, which had been very badly mauled indeed by a tiger about the face and neck—one of the healing scars being over 2 feet in length. This bison was in a herd of 19 and none of them appeared aggressive, least of all the bull which I shot.

Perhaps some more experienced person can put forward other theories?

ROUSDON MULLAI ESTATE,
DEVALA P.O.,
NILGIRI WYNAAD,
23rd April, 1951.

ANGUS F. HUTTON

5. THE GREAT INDIAN RORQUAL OR FIN-WHALE *BALAENOPTERA INDICA* BLYTH OFF UMARGAM (BOMBAY STATE)

The carcase of a whale—*Balaenoptera indica* Blyth, was washed ashore at Umargam on 14th May, 1951 (100 miles off Bombay on the B.B. & C.I. line) which had the following measurements.

Total length (tip of snout to tip of flukes) 74 ft.
do (do to centre of flukes) 68 ft.
Fluke 6 ft.
Height 5 ft. 5 inches.
Snout 13 ft. 6 inches.
Width just behind the head, between flippers 21 ft.
Flipper 6 ft. 1 inch.
Lower jaw 16 ft. 3 inches.

The carcase was in a high state of putrefaction rendering any anatomical examination impossible.

The last whale record off Bombay was that of an immature specimen—*Balaenoptera* sp.—stranded at Mahim on 12th April 1949 taping 20 ft., published in Volume 48, No. 2, pp. 358, by Mr. N. G. Pillai.

Bombay Natural History Society,
Bombay,
24th May, 1951.

V. K. CHARI.
Assistant Curator.

6. BIBLIOGRAPHY OF BIG GAME HUNTING AND SHOOTING IN INDIA AND THE EAST

[Published in Vol. 48, No. 2. (August 1950).]

Addenda

The following titles to be added :—

	Author	Title	Published
29 a.	Berg, Bengt ...	Pa jakt Enorningen. Deals with Rhinoceros and some other animals. 67 plates.	1932
29 b.	„ „ ...	'Tigrar'. Tiger and other animals, scenery and people. 68 plates.	1934
53 a.	Burton, Capt. R. G.	Tropics and Snows.	1898
58 b.	Carruthers, Douglas	Beyond the Caspian.	1950
73 a.	Cunningham, Col. A. H.	Indian Shikar Notes.	1929
77 a.	Demidoff, E. ...	A Shooting Trip to Kamchatka	1904
92 a.	Fawcus, L. R., I.C.S.	Report of the Game and Game Fishes Preservation Committee on the existing species of Game in Bengal including a specially interesting article on the Rhinoceros in Bengal.	1943
114 a.	Gordon Graham, B. N.	Hunter at Heart.	1951

	AUTHOR	TITLE	PUBLISHED
143 a.	*Journal of the Darjeeling Natural History Society.*	1923 to 1930. Title changed in 1930 to the *Bengal Natural History Society*, 1930 to 1949 and onwards (?)	
155 a.	Lambert Cowley.	A TRIP TO CASHMERE AND LADAK (in 1874)	1877
169 a.	Mathias, H. V ...	FIVE WEEKS' SPORT IN THE INTERIOR OF THE HIMALAYAS.	1864
174 a.	Mohan Jai Ram Gir, Shri	USEFUL INSTRUCTION IN SHOOTING. (Printed in English and Hindi in parallel columns. Thirteen chapters, and a number of very amusing illustrations.)	1885
36 a.	Bloomfield, Col. Arthur ...	THE DOINGS AND DESTRUCTION OF THE MOST MURDEROUS ROGUE (C.P. elephant).	——
160 a.	Leveson, H. A. ...	HUNTING GROUNDS OF THE OLD WORLD. Part I. India; Part II. Circassia; Part III. Algeria; Part IV. Firearms Hints.	1878 (?)

CORRIGENDA

On page 235, under *Lydekker*, enter :—

6 a.	Lydekker, R. ...	CATALOGUE OF THE HEADS AND HORNS OF INDIAN BIG GAME bequeathed by A. O. Hume, Esq., to the British Museum of Natural History.	1913

On page 235. *Pigsticking*. Insert between the two entries :—

" Raoul " ...	PIGSTICKING IN BENGAL.	——

On page 239, under *Lion*, enter :

23 a.	Lion ...	THE KATHIAWAR LION. By Lt.-Col. A. A. Fenton. Vol. 20, No. 3, pp. 737 to 752. This deals with hunting the Lion in Gir Forest.	1911

Opposite item 23, enter year of publication 1909

On page 239, under *Lion*, strike out the line: (*also see Vol.* 48. 493–515, 1909)

On page 239, enter :—

23 b.	Lion ...	THE GIR FOREST AND ITS LIONS. By M. A. Wynter-Blyth.	1949
		Part I. With a Map. A full and informative description of the area. Vol. 48, pp. 493-514.	1949

Part II. By M. A. Wynter-Blyth and Kumar Shree Dharmakumarsinhji, Vol. 49, No. 3, pp. 456-470. The Test Count—The Census—Conclusions and Recommendations—History of Junagadh Lions 1886 to 1936.	1950
Part III. By K. S. Dharmakumarsinhji and M. A. Wynter-Blyth, M.A. Vol. 49, No. 4, pp. 685–694. Vegetation—Habits and measurements.	1951

On page 237, opposite item 14, last line, enter year of publication. 1925

WANTED. Year of publication of items : 58 b, 89, 90, 139, 209 and of 'Pigsticking in Bengal' by 'Raoul'.

Members able to supply the above wants, or to make any suggestions for further additions or amendments are asked to send these to the Honorary Secretary.

BANGALORE,
15*th June*, 1951.

R. W. BURTON,
Lt.-Col. I.A. (Retd.)

7. CROWS HAWKING FISH ON WING

It was early morning of December 31, 1945 and I was walking along a high bank of the tank at Unjha (a big town on B.B. &. C.I. Railway, 54 miles north of Ahmedabad), when my attention was attracted by a number of herons and egrets flying over the calm water of the tank. When crossing over from one side to another, the birds flew very low, sometimes actually skimming the surface and at suitable places, they would dip their long bills with part of neck into the water and pick up fish which they swallowed upon reaching the bank. What was more remarkable was the presence of some House Crows among them, behaving likewise. These crows, about eight in numebr, were flying in company of the herons and egrets, though not so near the surface, and imitating their companions by actually diving for fish ! They did not penetrate the water very deep but just broke the surface, and were not always successful in catching fish. But whenever they were able to strike a catch, the crows left the herons and egrets and immediately flew to the nearest bank and devoured the fish piecemeal. After consuming the fish, they returned to join the herons in fishing. As the crows are constitutionally unfit for aquatic life, their diving stunts appeared ludicrous. They looked particularly foolish when a pariah kite—one of several hovering about—pursued an unlucky crow with a fish in its bill and snatched away the tasty morsel. This game went on for quite a time till the sun rose and the tank began to be crowded with cattle and human beings, when the herons and egrets retired to the shelter of neighbouring trees. The crows too, in the absence of their companions, lost interest in fishing and flew off elsewhere.

SANATORIUM, SHAHIBAG,
AHMEDABAD,
9th May, 1951.

HARINARAYAN G. ACHARYA

8. MATING OF THE HOUSE CROW (*CORVUS SPLENDENS SPLENDENS* VIEILLOT)

I am to record the following two experiences which, I hope, will further help to clear the mystery that still seems to surround the mating habits of the Indian House Crow in some quarters.

In May, 1946, having been bitten by a mad dog, I had to attend the Civil Hospital daily for a fortnight for taking a course of anti-rabic treatment. This hospital is situated in the heart of the city and is much overcrowded at all hours. On the 17th of the month at 12 noon, after taking the injection I was leaving the hospital when a pair of House Crows flew down from an adjacent tree, apparently quarrelling, and settled on the ground in the middle of the main gate and exactly in front of my bicycle. To avoid injuring the birds, I instantly stopped the bicycle and without alighting, waited for the birds to fly away. Watching closely, I found that the crows were not fighting but what appeared to be a 'quarrel' was actually their way of expressing endearment and mutual love preparatory to mating, for immediately on reaching the ground, the pair started copulating. The female was sitting on the ground and the male bird was treading her in the normal manner of birds. The pair were so engrossed that the continuous passage of human beings through the gate and the noise and bustle around them did not seem to disturb them.

The birds were hardly a couple of feet from my bicycle and I could observe the whole function minutely from start to finish. During the act the male was cawing somewhat loudly but the female only uttered a sweet and low cooing expressive of her satisfaction. The act continued for some seconds, when the male bird got off the back of his mate and both flew away together into a tree and I proceeded on my way. About a week after the above incident I got another opportunity to observe the mating of House Crows. On 26th May 1946 I was returning home after getting my regular dose of injection at the hospital. Outside the city limits, on the road leading to the Cantonment, I heard a loud cawing from a roadside tree. I got off my bicycle to investigate. The female crow was calling softly from a branch in a nim tree, and the male bird was loudly replying from a superior branch in the same tree about ten feet away. This continued for two or three minutes, when the male bird flew down from the upper branch, mounted the female bird and copulated with her. In this case also there was no haste during the act and both the birds were silent except for a soft cooing by the female bird as before. The act must have lasted a few seconds, when the pair separated and flew away to different trees. The time of day was 1 p.m.

SANATORIUM, SHAHIBAG,
AHMEDABAD,
9th May, 1951.

HARINARAYAN G. ACHARYA

9. LARGE GREY BABBLER ATTACKING METAL HUB-CAP OF CAR

In the third week of March, I was staying with friends at 8, King George's Avenue, New Delhi. One morning, as I was walking about in the garden, I heard strange sounds from the direction of my car which was standing under a tree on the lawn. I found a Large Grey Babbler behaving exactly as described by Mr. H. G. Alexander on p. 550 of the Society's *Journal* for December 1950. I am sure Mr. Alexander will be interested to read of this 'Parallel Experience' of an old friend.

'Southwood'
Mussoorie U.P.
22nd April, 1951.

HAMID A. ALI

10. BIRDS ATTACKING THEIR REFLECTIONS

I am inclined to disagree with Mr. H. G. Alexander in his opinion that the babbler which attacked the hub-cap of his car did so for auditory rather than for visual reasons (p. 550 of the *Journal*, Vol. 49, No. 3).

I once had a similar experience with a House Sparrow (*Passer domesticus*) and a small shaving mirror. The latter, when pecked, made only a dull rattling sound, but my sparrow waged war on it for some hours with an appearance of extreme annoyance which I attributed to the clear reflection of himself which he had in front of him.

This happened in Mominabad in the north-western part of Hyderabad State, while I was spending a couple of days in a dak bungalow. The sparrow, a cock bird, arrived in my bathroom shortly after I had unpacked my kit and at once began to attack my shaving mirror, chirruping hard. He kept this up for the rest of that day and for the whole of the next morning, until I packed up once more to leave. He was absent during the day for only very short intervals. I had ample time to spare and so sat for some hours watching him, and when I realised how engrossed he was in his campaign, I drew a chair close up to the scene of operations and in a very short time, by making my hand the only convenient place on which to stand in front of the mirror, I had him perching on my finger and continuing his attacks from there.

That he was really annoyed with his imagined rival, I am quite certain, for he permitted me to raise my hand some distance in the air so long as I kept the mirror near with the other hand. As soon as I lifted him too far from the mirror he would hop off my finger and carry on the fight from some other vantage point. He even ended up by pecking fiercely at my knuckles when he could not get at the mirror, and I am convinced that had he been merely fascinated by the sound of his beak against the glass he would not have been so fearless of my movements. As it was, I think that he was indeed so concerned with the rival in the mirror on whom he could make no impression, that he failed to react in the normal way to the presence of a by no means motionless human hand.

Hongkong House,
Calcutta,
28th April, 1951.

P. F. CUMBERLEGE

11. STRANGE BEHAVIOUR OF THE JUNGLE BABBLER (*TURDOIDES TERRICOLOR*)

One of our neighbours owns a Hillman car, which he occasionally parks for the night in the compound in front of our house. The wheels of this car have shining convex nickel-plated hub-caps with a smooth surface. On Sunday, the 6th May 1951, at about 7 a.m., I was idly watching three Jungle Babblers (*Turdoides terricolor*) feeding on the ground in front of my house. When they reached the front off-side wheel, they suddenly started jumping up and pecking vigorously at their reflections in the metal hub-cap. A fourth bird joined them. The pecking was so vigorous that the loud and sharp 'thud' 'thud' of their beaks on the metal plate could easily be heard at a distance of 25 yards. Not satisfied with jumping up from the ground to peck, two of the four birds took their station on the rim of the metal cover on opposite sides and kept on drumming. This must have lasted for over a minute when, apparently disgusted by the cowardly behaviour of their opponents within, the four babblers in a body moved to the rear off-side wheel and repeated the performance with very little variation. This time only the original three birds took part in the onslaught; the fourth bird, after a couple of half-hearted pecks, lost interest in the fray and moved away in search of better sport. The three musketeers, when they found that even here there was no response to their challenge, again returned to the front off-side wheel and renewed their attacks once more. After a time, they went round the front end of the car to its other side and started pecking on the metal cover of the front right-side wheel. After vigorous pecking for a minute or so, when they found that their attempt to provoke the birds there also failed, they got under the car and crossed over to the other side and started pecking at the cap on the front off-side wheel. Meeting with continued lack of response the three babblers quieted down and without further efforts flew away to fresh pastures.

On 8th May, 1951 I again—this time in company of my family and several children from the neighbourhood—witnessed the same performance repeated. The time was 1 p.m.; the number of performers 2 to 4 Jungle Babblers. The attack was repeated at intervals of a few minutes: this time only on the front and back hub-caps on the off-side of the car which was in shade, the birds moving in and out of the adjoining shrubbery for repeated attacks. They were still at it when I left the place at 1.45 p.m.

The metal covers are 12″ across and their lower edge comes to within about 7″ of the ground level. On examination I found that the figures of the attacking birds reflected in the metal cover, though much reduced, were in no way distorted, for squatting at a distance of a couple of feet from the wheel, I found my own reflection quite proportionate.

Our house is situated in a big compound with several large trees and a small garden. There are about 23 Jungle Babblers living in this compound. The birds are sometimes found moving together, but usually they live upto their name of 'Sāt Bhāi': 'Sāt', here meaning anything from five to nine. They are absolutely fearless and boldly enter our house whenever they wish to. On the verandah, we have a wide sofa-like wooden swing, fitted with a looking glass in the middle of the back-rest. This has always proved a red-rag to the Jungle Babblers. Every day and at all hours, a party of these birds comes to the mirror and whiles away considerable time in pecking vigorously on the glass surface at their own reflections in it. When the attackers are more than one, they, instead of jumping up from the floor of the swing and pecking on the mirror, actually fly to the sides of the mirror and holding on to the rim with their feet, peck their heads away. Getting tired of the unbearable mixed noise of their vocal clamour and hammering on the glass, my wife often covers the mirror over with a thick blanket or a folded saree. The birds, however, do not find the eight folds of a saree a great deterrent and undaunted they boldly go under the folds of the cloth and start jumping up and pecking at the mirror behind the curtain. The undulating swift movement of the folds of the saree covering the mirror, gives the illusion of a writhing snake attempting to free himself of the covering.

We are living in this compound for the last thirteen years and during that period, the Jungle Babblers have been our constant companions and they breed here. I cannot say whether they are the same birds, but there is no great variation in their number. I have never seen either the Large Grey Babbler (*Argya malcolmi*) or the Common or Striated Bush-Babbler (*Argya caudata*) in our compound, though, several years back, two pairs of the Rufous-bellied or Mount Abu Babbler (*Dumetia hyperythra albogularis*) had built their nests close to the wall of our house—one, on ground, in depression at foot of a cactus plant, 4 eggs, 11-6-1938; the other in a Kund (*Jasminum arborescens*) bush about 2 ft. from ground, 3 eggs, 25-8-1938.

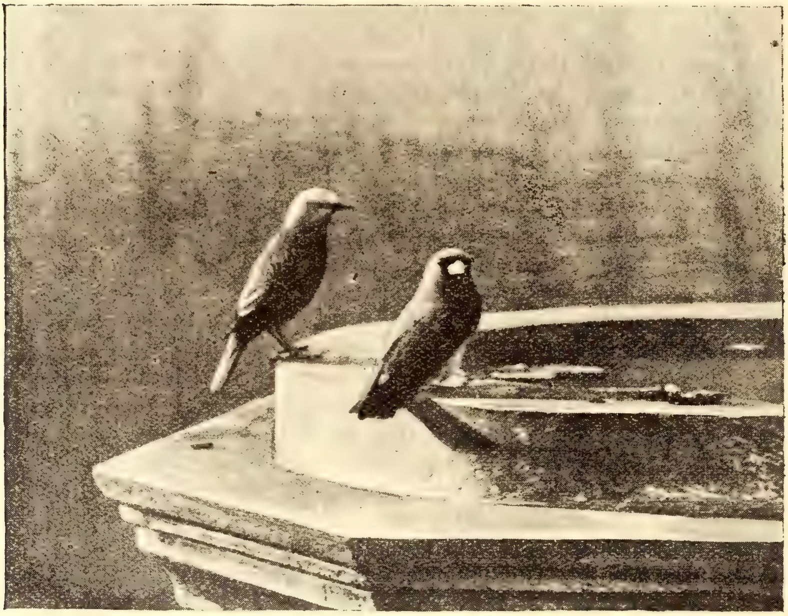
The Jungle Babblers are extremely noisy and their boldness is remarkable. For the past several years, our household has been lorded over by a family of pet cats. By nature very quiet and always well fed, some of these cats sometimes do hunt birds, if the effort is not too great. Their usual prey has been squirrels, pigeons, doves, an occasional myna and once a Red-vented Bulbul who had become so bold as to attempt to pick up food from the cat's table. Even the nimble-witted Magpie Robin has not been able to escape the attention of a wary cat. But, strange to say, the cats have never preyed on the Jungle Babblers. Usually the cats' food-plates are placed on the verandah in front of the kitchen and a variety of birds come to feed from it. But they hardly dare to fly down to the plates if any of the cats is about. Not so the Jungle Babblers. They not only come to the plates but actually 'mob' the cat, who enjoying her siesta, finds the tremendous babbling too much for her sensitive nerves and moves away elsewhere, leaving the field to the babblers. The cats, some of them at least, always dare the peacocks and peahens that come every morning and evening to our house to be fed by my wife, but until now no cat has ever caught any of the Jungle Babblers or has even molested or pursued them. Perhaps the cat, being an epicurean in her tastes, does not fancy the Jungle Babbler. Who can say!

SANATORIUM, SHAHIBAG,
AHMEDABAD, HARINARAYAN G. ACHARYA
8th May, 1951.

12. THE ASHY SWALLOW-SHRIKE (*ARTAMUS FUSCUS* VIEILLOT) AT A BIRD BATH

(*With a photo*)

Although I have no evidence of this Swallow-Shrike actually settling on the ground I have proof of the nearest thing to it. Some years ago while staying with my friend, the late H. V. O'Donel, on the Huldibari Tea Estate in the Duars, the bird bath was visited by a Grey-headed Myna [*Sturnus m. malabaricus* (Gmelin)]. The bath was in the garden quite close to the house. Immediately afterwards an Ashy Swallow-Shrike settled on the plinth quite close to the myna. As my friend had a permanent hide near the bird bath this photograph was easily obtained. I consider this observation of sufficient interest for record.



KENILWORTH,
COONOOR,
NILGIRIS,
14th April, 1951.

C. M. INGLIS,
F.Z.S., C.M.B.O.U.

13. OCCURRENCE OF HODGSON'S PIPIT (*ANTHUS ROSEATUS*) IN SAURASHTRA

It was at the end of March and beginning of April that I witnessed the return migration of different kinds of wagtails on the Gaurishanker lake, Bhavnagar. There were a multitude of them, but what attracted my attention was a pipit, much like our tree-pipit, walking by itself on the green grass close to the water's edge. It was brighter but appeared much the type which Horace Alexander had recently pointed out to me in Delhi as Hodgson's Pipit. That bird I never saw again, but in trying to rediscover it I came across a number of others in fresh plumage—vinous pink or warm buffy breasts, heavy striations on the upper parts and conspicuous black streaks on the flanks—answering to what Alexander had described as their breeding plumage. There were also a few without the bright breasts. But as I had never met the species here before, specimen collecting was the only way of confirming my identification. It was more than difficult to approach the birds as they took wing just out of range; and as soon as I flushed a bird it chased another and the pair settled far away, always keeping to the waterside. I finally managed to collect three of which two were sent to the Bombay Natural History Society for verification. Sálim Ali informs me that he has never seen this species from further south than Gwalior so this would seem to be a new record.

Dil Bahar,
Bhavnagar, K. S. DHARMAKUMARSINHJI
1st *May*, 1951.

14. DISTRIBUTION OF THE BLUE-BEARDED BEE-EATER [*NYCTIORNIS ATHERTONI* (JARDINE & SELBY)]

With reference to 'Notes on some Asiatic Meropidae' by Daniel Marien in Vol. 49. No. 2 (p. 162) I have to point out that Mr. E. H. N. Lowther in his book 'A Bird Photographer in India' reports on page 34 the occurrence of the Blue-bearded Bee-eater at Topchanchi Reservoir in the Manbhum District of Chota Nagpur.

I have also come across another reported occurrence of the species in Chota Nagpur, where according to Mr. Marien the bird has not been seen. A pair was seen on 5-11-44 by Captain R. H. Baillie at Hazaribagh, and was reported by him in the *Journal of the Bengal Natural History Society* (Vol. XX, No. 4, April, 1946). Dr. S. C. Law commenting on Captain Baillie's recordings in a series of critical notes in subsequent issues of the same journal referred to his own experience of the bird-life of Hazaribagh and said that the Blue-bearded Bee-eater was rare in the District and its status and distribution uncertain.

I have never seen the Blue-bearded Bee-eater myself in Chota Nagpur proper, but I have seen it a little to the north-east at Gidhaur in Monghyr District. According to Mr. Marien himself the bird was collected in

Surguja, at Ramanujganj, which village is separated from the Palamau District of Chota Nagpur only by a narrow stream.

c/o SAMI AHMAD, ESQ., JAMAL ARA
FOREST REST HOUSE,
HINOO, P.O., RANCHI,
5th March, 1951.

15. 'BIRDS OF THE LONDA NEIGHBOURHOOD'.— A CORRECTION

In the *Journal* Vol. 45, p. 236 while referring to the erroneous records of the occurrence of *Gyps fulvus* around Bombay we doubted Koelz's inclusion of this species in the birds of the Londa Neighbourhood (*J.B.N.H.S.* Vol. XLIII, p. 28) where he claimed to have obtained a specimen and seen a congregation of 50 individuals. The last remark in particular prompted us to write for verification to the American Museum of Natural History where the collections are now housed, and we understand that the specimen is actually *Gyps indicus*.

114, APOLLO STREET,
BOMBAY, SÁLIM ALI
25th May, 1951. HUMAYUN ABDULALI

16. THE POSITION OF PLOVERS' EGGS IN NESTS

On Sunday the 13th May 1951 I visited the north end of Walwan Lake, Lonavla (Poona District) to examine a nest of the Little Ringed Plover (*Charadrius dubius jerdoni*) which Br. Navarro of St. Xavier's High School, Bombay, had discovered. The three eggs were laid in a slight hollow in the coarse sand—there being no appreciable nest—*with the points downwards*. The circular broad ends of the eggs alone were visible from above in the form of tiny domes.

K. S. Dharmakumarsinhji of Bhavanagar, to whom I mentioned this states that he has seen nests of both the Kentish Plover and the Little Ringed Plover with eggs resting in a similar vertical position.

This does not appear to have been recorded hitherto for Indian birds, though the 'Handbook of British Birds', Vol. IV, p. 361, says of the Kentish Plover (*Leucopolius a. alexandrinus*)—'Nest: Sometimes a mere hole in sand in which eggs are usually buried, points downward.'

c/o FAIZ & CO. HUMAYUN ABDULALI
75, ABDUL REHMAN STREET,
BOMBAY, *19th May* 1951.

17. BIRD MIGRATION IN INDIA

Since publishing the records in Vol. 47, pp. 690–699 and Vol. 48, p. 586 the following information has been obtained concerning two further recoveries of ringed birds from the Bird Banding Bureau in Moscow through the good offices of the Embassy of India in Moscow—

No. of ring	Date	Name of bird	Place where ringed	Remarks (adult or young)	Name of ringer	Date of recovery	Reported by	Place where recovered	Remarks
141339 D (MOSKWA)	21–7–1949	Pintail (*Anas acuta*)	Novosibirsk oblast Lake Chany, 54° 35′N 77° 40′E	female	Central Bird Banding Bureau, Moscow	27–12–1950	N. O. Blanchette of Aligarh	Putna in Etah District U.P.	
75550 D (MOSKWA)	8–8–1939	Mallard (*Anas platyrhynchos*)	Astrakhan Preserve (Volga Delta)	male	Central Bird Banding Bureau, Moscow	14-1-1942	Major E. J. Van Ingen	Faidah, about 30 miles north of Mosul, Iraq	

114, Apollo Street, Fort,
Bombay, 2nd May 1951.

EDITORS.

18. 'NOTES ON SOME ASIATIC STURNIDAE (BIRDS)'— A COMMENT

In his paper in the December issue of the Bombay Natural History Society's *Journal* (**49**, 1950, pp. 481 and 484), Mr. Daniel Marien has made some comments about two new races of Indian starlings proposed by me (*Postilla*, No. 1, 1950). In the case of the first form, *Sturnus contra sordidus*, Mr. Marien has quoted part of my description and the range as given, and then goes on to add that a single specimen in the Rothschild Collection in New York shows none of the stated characters of this race.

In the case of the second form, *Acridotheres cristatellus fumidus*, Mr. Marien has quoted part of my description and the range which is north Cachar and Lakhimpur and the Mishmi Hills in Assam. In this case Mr. Marien has looked at four worn males from the Khasia Hills and finds none of the characters of *fumidus* in these birds.

In view of the fact that Mr. Marien has looked at one specimen of *Sturnus contra* from the range of *sordidus* and four specimens of *Acridotheres cristatellus fumidus* from the Khasia Hills which is *not* in the range as given by me—the Khasia Hills being west of Cachar—it becomes difficult to take the rest of his critical remarks too seriously. Since reading Mr. Marien's paper I have checked my original conclusions by sending my types and accompanying series of each of these forms to another museum requesting independent confirmation of my findings. I have been pleased that the colleague who examined this material and who is familiar with Asian birds, has agreed with me and has upheld the characters of my races as published. I should point out, however, that on p. 4 of my description of *fumidus*, where it has been compared with *grandis*, the printed word should be 'lighter' rather than 'dark'. But this point is immaterial in the present discussion.

The factor which at once appeared surprising to me in reading Mr. Marien's paper is that the American Museum of Natural History in New York City, where the collections are housed of which this gentleman writes, and the Peabody Museum of Yale University where the material to which he refers is located, are only seventy-five miles apart. It is extremely easy to communicate by a variety of means between these museums. In fact I myself am frequently in the New York institution working on ornithological research, and in the seventeen years that I have been associated with that institution as a co-worker in ornithology I have borrowed material freely at all times and always been accorded numerous gracious courtesies. From a physical point of view therefore there should be no impediment to ready exchanges. From a scientific point of view it is not thorough or systematic to leave such ravelled edges to a review of species. Occasionally a museum may be encountered whose philosophy may include the feeling that 'a subspecies is not a subspecies if it is not included in our collection,' but I am sure from my experiences in New York that this can hardly be the philosophy of my colleagues there nor could Mr. Marien have been so indoctrinated. It is far too unscientific. Nor can such a lack of liaison do anything but cast doubt upon the professional capabilities of the museum workers concerned, and thus tend indirectly to discredit the profession as a whole.

PEABODY MUSEUM OF NATURAL HISTORY,
YALE UNIVERSITY, S. DILLON RIPLEY
NEW HAVEN, CONNECTICUT, U.S.A.
5th May, 1951.

19. DURATION OF SONG IN SOME COMMON BIRDS

(With five graphs)

During April, 1950, I was at Daltonganj, the headquarters of the District of Palamau in Bihar. The residence I was occupying had several young mango trees in its compound, but on the north a large orchard adjoined. This orchard was in a sadly neglected condition, but from my point of view was ideal. Apart from the fruit trees i.e. mango and guava, this orchard had several other species, mainly *Butea frondosa, Broussonetia flabellifera, Cassia fistula, Poinciana regia, Bombax malabaricum, Azadirachta indica,* and *Tamarindus indicus.* There was a dense undergrowth of lantana and coarse spear grass (*Imperata arudinacea?*). Twenty-seven species of birds were seen by me in this area during a stay of approximately 4½ months, out of which eight species had started nesting by the middle of April when I left. The territories of the Crimson-breasted Barbet [*Megalaima haemacephala* (Muller)] and the Magpie-Robin (*Copsychus saularis* Linn.) were very well defined and comparatively narrow, and were incorporated by me in a single field sketch. While studying the territories of these birds, I was struck by the remarkable periodicity their songs seemed to have, and I decided to time them over a number of days to check up this impression. Observations started at 5 a.m. and were continued till after sunset over a period of 10 days. Neither of these species commenced calling before 5 a.m. and so this hour was selected as a convenient starting point for the observations. No observations could be made after dark. By confining my observations to the territories of these birds I ensured that the singing time of the same individual was noted over the entire period. At the same time I made observations on the Papiha or Brain-fever Bird (*Hierococcyx varius* Vahl.), and the Koel (*Eudynamis scolopaceus* Linn.) as well. But as these birds have apparently no fixed territories I am unable to guarantee that the same individual was concerned throughout the period. All the same it must be noted that only a single pair of each species had been observed in the area over a long period of time, so it would not be unreasonable to presume that the individual birds observed during the entire period of 10 days were the same. Observations on the Yellow-cheeked Tit (*Machlolophus xanthogenys* Vigors) made at Ranchi in the first week of May 1950, were confined to the territory of the nesting bird.

The duration of each burst of song was timed with a Rolex Oyster wrist watch fitted with a centre second hand and noted against the hour at which the song was heard. On the completion of the observations, the total duration of song over each clock-hour was averaged and plotted against the middle of that clock-hour. It will therefore be noticed that all the curves began from 5.30 a.m., but the inference should not be drawn that all these birds started calling precisely at that time. This time is just the middle of the clock-hour from 5 a.m. to 6 a.m. and the time against it expresses the total duration of the call during this particular clock-hour. The same remark applies to all the points of the curve. The results may be summed up as under:—

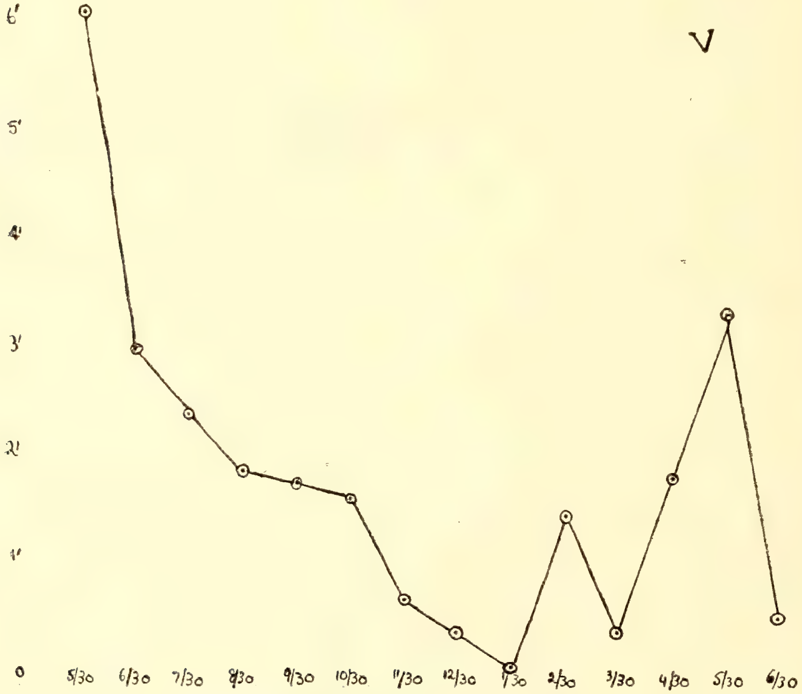
Magpie Robin, Male.—A peak early in the morning, followed by a very steep descent to the middle of the day. A minor peak again late in the afternoon.

Crimson-breasted Barbet.—A peak in the early morning followed by a minimum between 7 and 8 a.m. Then follow peaks of increasing amplitude culminating in another maximum late in the afternoon.

Yellow-cheeked Tit.—Two pronounced maxima early morning and late afternoon, with a subsidiary peak late in the morning.

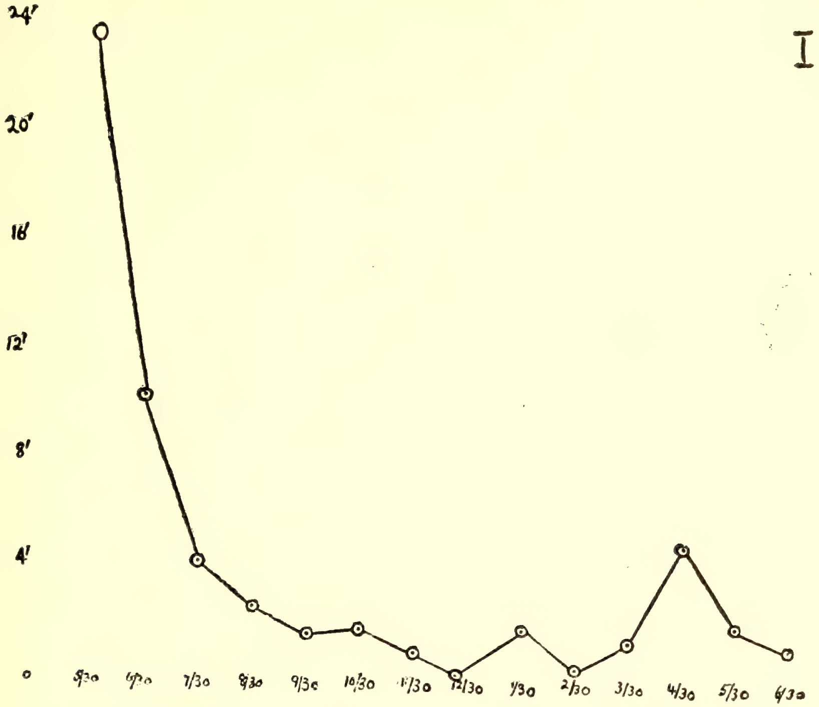
Brain-fever Bird (Papiha).—A maximum between 6 and 7 a.m. followed by peaks of decreasing amplitude, culminating in another maximum in the evening.

Koel.—A very pronounced maximum early in the morning followed by a steep fall; a subsidiary peak early in the afternoon, culminating in another maximum in the evening.

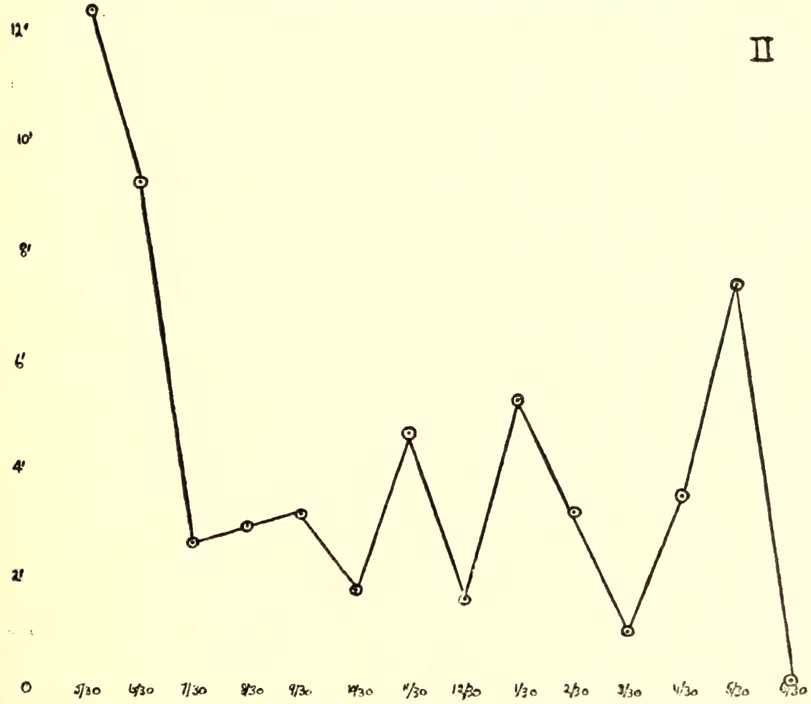


Koel (*Eudynamis scolopaceus*) ♂

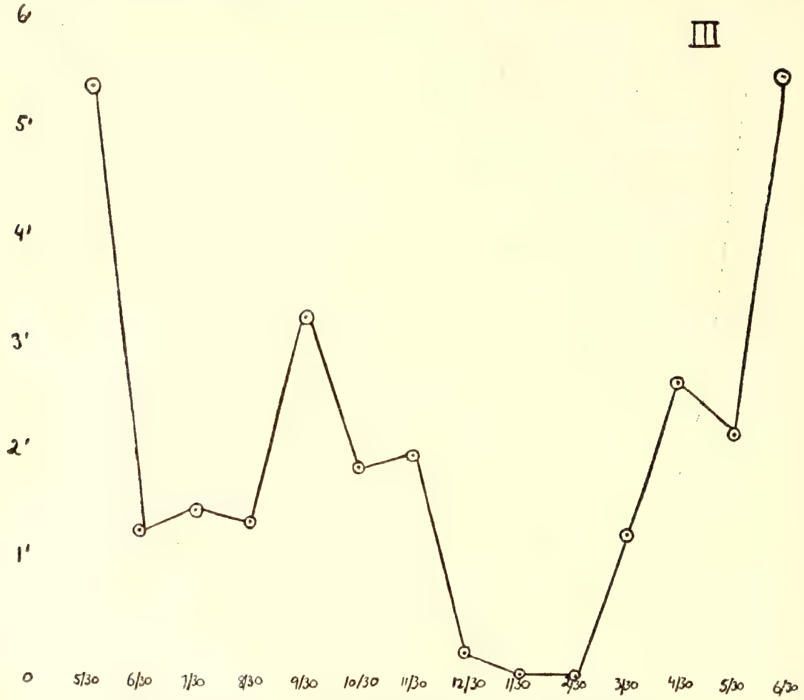
The weather throughout was warm with one or two cloudy days. Dust storms were fairly common throughout the interval, generally in the afternoon. Average time of sunrise was 5.50 a.m. and sun-



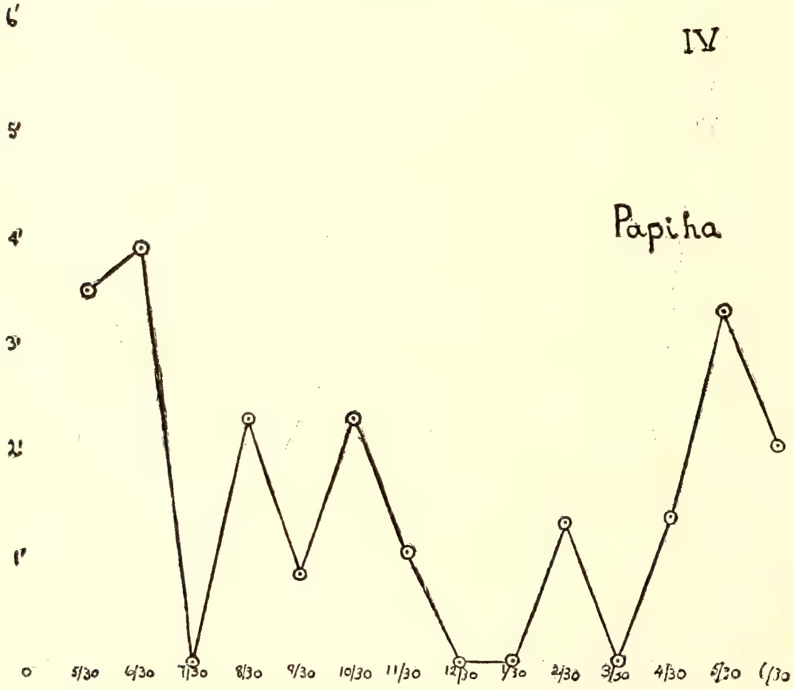
Dyalh or Magpie-Robin (*Copsychus saularis*) ♂



Crimson-breasted Barbet (*Megalaima haemacephala*)



Yellow-cheeked Tit (*Machlolophus xanthogenys*)



Papiha or Brain-fever Bird (*Hierococcyx varius*) set 6.15 p.m. No attempt was made to co-ordinate the duration of calls with the type of weather prevailing. It is hoped to make this the subject of a future study.

I am not aware if such studies have been made on Indian birds before. No such information is available from the literature in my possession. I shall be much obliged if any reader will put me in touch with earlier observations of this nature.

The total output of song in a day of approximately 12 hours and 25 minutes for each of the species under observation was as follows:—

1. Magpie Robin (male)—53.6 minutes.
2. Crimson-breasted Barbet—58.5 minutes.
3. Yellow-cheeked Tit—28.7 minutes.
4. Brain-fever Bird (Papiha)—21.8 minutes.
5. Koel (male)—24.5 minutes.

SUMMARY

During April and May, 1950, observations were made on the duration in minutes of songs of 5 different birds at hourly intervals. The results show that peaks occur in the morning and evening with a period of comparative silence in the middle of the day.

JAMAL ARA

20. ANGLING FOR CROCODILES WITH HOOK AND LINE IN KRISHNARAJASAGAR RESERVOIR

It is common practice to angle for fish; but to angle for and land alive a crocodile is novel and very exciting.

The author started with the idea of devising a method to catch crocodiles on hooks. No data was available except local stories of live dogs and cats being used as baits with country-made hooks tied around their necks and left tethered on the river bank in likely spots.

The method of catching fish on night-lines with bait could be suitably modified for the purpose in question by using bait other than live cats or dogs.

Hook.—The largest size of Norwegian fish-hooks i.e. No. 1 size 3 in. long by $\frac{1}{8}$ in. thick were procured. As double hooks are not available, two such hooks were jointed shank to shank so as to have the prongs facing out.

Line.—Strong coir rope, 100 ft. long, $\frac{1}{2}$ in. in diameter and hand-twisted was used.

Bait.—At first chunks of butchers' meat were used. But with the heavy hooks and stout ropes the whole bait sank to the bottom and no results were achieved over half a dozen trials. Since while lining for fish the baits whether alive or otherwise would float on water, it was thought better to give a floating bait to the crocodile. An empty sealed tin was used as buoy, but 3 or 4 trials resulted in failure.

Now it was decided to change the bait; as such, sheeps' lungs was chosen this time to replace meat. Sheeps' lungs besides being cheap are capable by themselves of remaining afloat even with the heavy hook imbedded inside.

On the first attempt when the baited hook was left overnight and examined the next morning, the rope (minus bait and hook) was found floating in the water, the cut-end of the rope clearly showing that it had been chewed up between the jaws of a crocodile. This kindled hopes of eventual success. To prevent the hook being torn away a one yard length of the line between hook and coir rope was made up of about a dozen thin but highly twisted cotton rope-strands loosely put together. As each strand was only ¼ in. in diameter, it was expected that the strands would slip between the 'V' shaped teeth of the crocodile and thus escape being bitten through.

Attempts were renewed and quickly met with success as narrated below.

9-4-50.—At 7 p.m. the baited hook was taken out and left floating about 20 ft. from shore where the water depth was about 10 ft. The other end of the rope was strongly secured to a steel crow-bar driven deep into the ground.

10-4-50.—At 6 a.m. it was noticed that the bait was no longer floating. A slight exploratory pull on the rope resulted in violent disturbance in the water and the crocodile made himself visible by lashing out his tail. When it was made certain that the reptile was properly hooked, the problem was to secure him alive. The alternative was to get him shot.

A second rope was procured and placed in a loose-hitch on the first rope. By having two men pull on this rope, the crocodile was, with great difficulty slowly hauled ashore and held between the two ropes.

A running noose was, with great difficulty, placed over the snapping jaws; and another secured the lashing tail. The crocodile was now hitched up between two stout and long bamboos. It took 8 men to carry him over to the dam-side where he was left in a shallow fountain sufficiently well secured. It measured 10 ft. 9 in. The hook was deeply imbedded and could not be safely dislodged.

11-4-50.—The next morning the crocodile was found dead, obviously due to hook-injuries as the hauling-in caused the hooks to tear deep in the guts. This was later confirmed.

Post-Mortem.—The hook was found deep in the guts in the stomach-region and large tears in the abdominal wall were found.

Examination of the guts disclosed some remarkable contents. (1) over a dozen pieces of bone 3-4 in. long and 1-1½ in. in diameter. The bones were broken up, hence it was not possible to make out whether they were human or animal in origin. (2) about a dozen pebbles ½-1 in. in size and worn smooth. (3) human-body remains:—a human left hand cut off at the wrist and a human left foot cut at the ankle. These were fairly fresh except that the colour was very pale. Finger and toe-nails were nearly intact. Loosely hanging nerves and muscles indicated that swallowing had been fairly recent.

Conclusion.—The above method having met with success deserves to be tried out regularly and further developed. The elimination of these dangerous reptiles is very necessary for the safety of the villagers and their cattle not to speak of the thousands of fish that must be destroyed by the large number of reptiles that inhabit the reservoir.

DEPARTMENT OF A.H. SERVICES, D. R. KRISHNAMURTHY
BANGALORE. *Fishery Research Assistant*
15*th April,* 1951

21. A CURIOUS DEATH OF A SNAKE

On 29-4-1947, the senior author found a dead *Tropidonotus piscator* (Schn.)—popularly known in Oriya as 'Pani Dhanda'—in his pond in the heart of Cuttack. On examining for the cause of death it was found that the snake had in its mouth cavity an entire fish *Callichorous pabda* (Day). The fish specimen measured 8.11 inches in length and 3.7 inches in its greatest circumference. The snake was an adult measuring 3 feet 1.6 inches in total length. The species is common in our ponds and subsists on fishes. It is probable that the pectoral spines of the fish stuck in the snake's mouth and so it could not be swallowed, neither could it be rejected owing to the nature of curved teeth characteristic of the Ophidians.

We are thankful to Sri S. R. Upadhyay of our laboratory for the determination of the fish and to Prof. D. Mukerji of the Department of Zoology, University College of Science, Calcutta University for kindly going through the manuscript.

Department of Zoology,
Ravenshaw College,
Cuttack

B. K. BEHURA
M. A. JOHN

22. EGG-LAYING BY A PYTHON IN CAPTIVITY

Your *Journal,* December 1947, published a note of mine on the breeding of the Indian Python (*Python molurus*).

Details up to date, 21st May 1951 are as follows:—

On 4 April 1938 this python, a pet of mine, mated with a small male, and laid eggs on 4 June 1938. After 4 April 1938 no male pet python has ever been near the cage.

Date	Number of eggs laid	Period of captivity
4 June 1938	(2 months after mating)	
9 June 1947	16	9 years
6 June 1948	20	10 ,,
5 June 1949	16	11 ,,
and 21 May 1951	12	13 ,,

These last eggs are: 7 of normal size 8½ inches round the centre.
10½ ,, ,, the ends.
5 small, the size of a goose egg.

Loyola College,
Madras,
21st May, 1951

C. LEIGH, S.J.

23. A RECORD OF THE COMMON MEMBRACID, *OTINOTUS ONERATUS* WALK. (HOMOPTERA : RHYNCHOTA) FROM THE CITY OF PATNA (BIHAR)

This is an extension of the distribution of the common membracid *Otinotus oneratus* Walk, in Bihar and an addition to the list of its hostplants. It was only reported from Ranchi in Bihar (Distant, W. L. 1907. 'Fauna of British India. Rhynchota', 4: 40-41).

Adults and nymphs of *O. oneratus* were collected by us in the garden of the Science College, Patna on 28-8-1950 from the following plants:—

1. *Carissa carandus* Linn.	Hindi:	Koiraundo
2. *Lagerstroemia indica* Linn.	,,	Swani
3. *Polyalthia longifolia* B. & H.	,,	Asoka

In all cases membracids were attended by the common black ant *Camponotus compressus* Fabr.

We are thankful to Sri Jangilal Srivastav of the Department of Botany, Science College, Patna for kindly identifying the plants.

DEPARTMENT OF ZOOLOGY,
RAVENSHAW COLLEGE,
CUTTACK.
DEPARTMENT OF ZOOLOGY,
SCIENCE COLLEGE, PATNA.

BASANTA KUMAR BEHURA
VISWANATH SINHA

24. GLEANINGS

Quenching thirst with raw fish.

'The old natives know well the device which many shipwrecked men hit upon during the war—chewing thirst-quenching moisture out of raw fish. One can also press the juices out by twisting pieces of fish in a cloth or, if the fish is large, it is a fairly simple matter to cut holes in its side, which soon become filled with ooze from the fish's lymphatic glands. It does not taste good if one has anything better to drink, but the percentage of salt is so low that one's thirst is quenched'.

Flying Cuttlefish.

During the course of the voyage several cuttlefish were found on the deck [of the raft] and even on the top of the roof of palm leaves. It was some time before the reason was discovered.

'One sunny morning we all saw a glittering shoal of something which shot up out of the water and flew through the air like large rain-drops, while the sea boiled with pursuing dolphins. At first we took it for a shoal of flying fish, for we had already had three different kinds of these on board. But when they came near, and some of them sailed over the raft at a height of four or five feet, one ran straight into Bengt's chest and fell slap on the deck. It was a small squid. Our astonishment was great. When we put it into a sailcloth bucket it kept on taking off and shooting up to the surface, but it did not develop speed enough in the small bucket to get more than half out of the water. It is a known fact that the squid ordinarily swims on the principle of the rocket-propelled aircraft. It pumps sea water with great force through a closed tube along the side of the body, and can thus shoot backwards in jerks at a high speed; and with all its tentacles hanging behind it in a cluster over its head, it becomes streamlined like a fish. It has on its side two round fleshy folds of skin which are ordinarily used for steering and quiet swimming in the water. But it was thus shown that defenceless young squids, which are a favourite food of many large fish, can escape their pursuers by taking to the air in the same way as flying fish. They had made the principle of the rocket aircraft a reality long before human genius hit upon the idea. They pump sea water through themselves till they get up a terrific speed, and then they steer up at an angle from the surface by unfolding the pieces of skin like wings. Like the flying fish, they make a glider flight over the waves for as far as their speed can carry them. After that, when we had to begin to pay attention, we often saw them sailing along for fifty to sixty yards, singly and in twos and threes. The fact that cuttlefish can 'glide' has been a novelty to all the zoologists we have met'.

Sharks and Shark-fishing.

'Generally it is smell more than sight which excites sharks' voracity. We have sat with our legs in the water to test them, and they have swum towards us till they were two or three feet away, only quietly to turn their tails towards us again. But if the water was in the least bloodstained, as it was when we had been cleaning fish, the sharks' fins came to life, and they would suddenly collect like bluebottles from a long way off. If we flung out sharks' guts, they simply went mad and dashed about in a blind frenzy. They savagely devoured the liver of their own kind, and then if we put a foot into the sea they came for it like rockets and even dug their teeth into the logs where the foot had been. There are sharks and sharks, because the shark is completely at the mercy of his own emotions'.

'The last stage in our intercourse, with sharks was that we began to pull their tails. Pulling animals' tails is held to be an inferior form of sport, but that may be because no one has tried it on a shark. For it was in truth a lively form of sport.

To get hold of a shark by the tail we first had to give it a real tit-bit. It was ready to stick its head high out of the water to get it. Usually it had its food served dangling in a bag. For if one has fed a shark directly by hand once, it is no longer amusing. If one feeds dogs or tame bears by hand they set their teeth into the meat and tear and worry until they get a bit off, or until they get the whole piece for themselves. But if one holds out a large dolphin at a safe distance from the shark's head, the shark comes up and smacks his jaws together, and without one having felt any tug half the dolphin is suddenly gone, and one is left sitting with a tail in one's hand. We had had a hard job ourselves to cut the dolphin in two with knives, but in a fraction of a second the shark, moving its triangular saw-teeth quickly sideways, had imperceptibly chewed up the backbone and everything else like a sausage machine. When the shark turned quietly to go under again, its tail flickered up above the surface and was easy to grasp. The shark's skin was just like sand-paper to hold on to, and inside the upper point of its tail there was an indentation which might have been made to allow of a good grip. If we once got a firm grasp there, there was no chance of our grip not holding. Then we had to give a jerk before the shark could collect itself, and get as much as possible of the tail pulled in tight over the logs'.

[We have here quoted at length from 'The Kon-Tiki Expedition' by Thor Heyerdhal (George Allen & Unwin Ltd., London, 1950) and cannot help mentioning that it is the most remarkable true adventure story we have read for a long time. It chronicles the voyage on a raft across the Pacific from South America to Polynesia in an attempt to prove a theory that the South Sea Islands were originally populated from South America.]

Oryxes caught alive.

The following is an extract from the *Day Bulletin* of the Arab News Agency dated 15th March 1951.—

'Recently the Emir Saud ben Juluwi was on a hunting trek in the Rab' el Khali, the great desert of Arabia, when his party came across a herd of 36 oryxes, the largest number to be seen together in many years.

With great personal bravery, the Emir's principal hunter captured several oryxes by leaping from a fast-moving car and grabbing the animals by their horns and throwing them to the ground in cow-boy fashion.

Two of the animals which the Emir's hunter captured alive, are now being kept at the Governor's palace in Hofuf.'

A Cure for Colic?

Col. O. Vickers in the *Field* of 3 February 1951 writes: 'While serving with General Younghusband's mission in Lhasa some 50 years ago I noticed many mules in the Tibetan and Bhutian caravans on the mountain tracks had only one ear. When one of my transport mules got colic and could not stand up, we gave him up for lost. A Tibetan came up to me and said, "Your mule will not die if you cut off his left ear." We performed the operation and the mule recovered.'

Gulls on Snow.

The Science Newsletter No. 6 issued by the Indian Scientific Liaison Officer in the United Kingdom, a copy of which was received by us from the Department of Scientific Research, Government of India, quotes from a report of the Arctic Health Research Centre of the U.S. Public Health Service, Point Barrow, Alaska:

'Gulls can walk indefinitely on snow at—50°C. Measurements were made of the rate of heat loss through the feet of live gulls when placed in iced water. This was so low that it suggests a rate of blood circulation at the rate of only a few cc. per hour.'

50,000 *Year old Lotus Seeds sprout now.*

Science Newsletter No. 17 quotes from the *Times* of 6th March 1951.

'Two lotus seeds estimated by officials of the National Park Service of the Department of the Interior to be 50,000 years old were to-day reported to be sprouting in a moisture chamber where they had been placed for germination tests.

These seeds, originally found in Manchuria by an archaeological expedition were presented to the Park Service last year. They had been kept in a safe until last week when it was decided to make these tests. The surfaces of the seeds were filed to make them more sensitive to water before they were placed in the chamber, where they are now showing green shoots. The age of the seeds has been estimated on the basis of the deposits in which they were found.'

CATALOGUE OF BOOKS IN THE BOMBAY NATURAL HISTORY SOCIETY'S LIBRARY

PART V—INVERTEBRATA

I—Invertebrata

I R—Invertebrata—Reference volume, not lent out.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
					Abercrombie, Alexander	(*See* Melvill, James Cosmo).
1	I	35	5	F	Agassiz, Alexander	REPORT ON THE ECHINI. Reports on the results of dredging in the Gulf of Mexico (1877-78), by the U.S. Coast Survey steamer 'Blake'—Memoirs of the Museum of comparative Zoology at Harvard College Vol. X. No. 1, 1883.
2	I	39	5	F	Agassiz, Louis	MONOGRAPHIES D'ECHINODERMES VIVANS ET FOSSILES, 1838.
3	I	6	5	D	Ashworth, J. H.	CATALOGUE OF THE CHAETOPODA IN THE BRITISH MUSEUM (NATURAL HISTORY). A. Polychaeta: Part I Arenicolidae 1912.
4	I	7	5	D	Awati, P. R. & Rai, H. S.	OSTREA CUCULLATA (The Bombay Oyster) — *The Indian Zoological* Memoirs on Indian Animal types (edited by Bahl, K. N.), 1931.
5	I	12	3	D	Baylis, H. A. & Daubney, R.	A SYNOPSIS OF THE FAMILIES & GENERA OF NEMATODA, The British Museum (Natural History), 1926.
6	I	37	5	F	Bernard, Henry M.	CATALOGUE OF THE MADREPORARIAN CORALS IN THE BRITISH MUSEUM (Natural History). The genus *Turbinaria*, the genus *Astraeopora*—Vol. II, 1896.
7	I	38	5	F	do.	do. the genus *Montipora*, the genus *Anacropora*—Vol. III, 1897. (for volume I *see* Brook, George).

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
8	I	36	5	F	Brook, George	CATALOGUE OF THE MADREPORARIAN CORALS in the British Museum (Natural History). The genus *Madrepora*, Vol. I. 1893. (For Vols. II & III *see* Bernard, Henry M.)
9	I	13	5	D	Clark, Hubert Lyman	A CATALOGUE OF THE RECENT SEA URCHINS (*Echinoidea*) in the collection of the British Museum (Natural History). 1925.
10	I	9	5	D	Colthurst, Ida	SHELLS OF THE TROPICAL SEAS, 1930.
11	I	10	5	D	do.	do.
12	I	42	5	E	Crouch, Edmund A.	AN ILLUSTRATED INTRODUCTION TO LAMARCK'S CONCHOLOGY, 1827.
					Daubney, R.	(*See* Baylis, H. A. & Daubney, R.)
13	I	30	5	D	Duncan, Winifred	WEBS IN THE WIND—the habits of web-weaving spiders, 1949.
14	I	32	5	D	Ellis, R. A.	SPIDER-LAND, 1912.
15	I	2	5	D	Fischer, Dr. Paul	MANUEL DE CONCHYLIOLOGIE et de Paleontologie conchyliologique ou Histoire Naturelle des Mollusques vivants et fossiles, 1887.
16	I	8	5	D	Hickson, Sydney J.	AN INTRODUCTION TO THE STUDY OF RECENT CORALS, 1924.
17	I	4	5	D	Hornell, James	THE SACRED CHANK OF INDIA. A Monograph on the Indian Conch (*Turbinella pyrum*), Madras Fisheries Bureau, Bulletin No. 7, 1914.
18	I	5	5	D	do.	THE COMMON MOLLUSCS OF SOUTH INDIA—Report No. 6 of 1921, Madras Fisheries Bulletin Vol. XIV, pages 97 to 215, 1922.
					Karandikar, K. R.	(*See* Subramanyam, T. V. Karandikar, K. R. & Murthi, N. N.)
19	I	18	5	D	Kennard, A. S. & Woodward, B. B.	SYNONYMY OF THE BRITISH NONMARINE MOLLUSCA—(Recent & post-tertiary), British Museum (Natural History), 1926.
20	I	3	5	D	Lang, William Dickson, Smith, Stanley & Thomas, Henry Dighton	INDEX PALAEOZOIC CORAL GENERA—British Museum (Natural History), 1940.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
21	I	19	5	D	Melvill, James Cosmo & Abercrombie, Alexander	THE MARINE MOLLUSCA OF BOMBAY. Reprinted from the Memoirs and proceedings of the Manchester Literary and Philosophical Society, Series 4, Vol. VII, 1893.
					Murthi, N. N.	(*See* Subrahmanyum, T. V. Karandikar, K. R. & Murthi, N. N.)
					Rai, H. S.	(*See* Awati, P. R. & Rai, H. S.)
22	I	20	5	D	Reeve, Lovell	THE LAND & FRESHWATER MOLLUSKS indigenous to or naturalised in the British Isles, 1863.
23	I	34	5	D	Robert, Paul A.	WONDERS OF THE SEA-SHELLS, 1945.
24	I	31	5	D	Savory, Theodore H.	THE BIOLOGY OF SPIDERS, 1928.
25	I	16	5	D	Shipley, Arthur E.	PEARLS AND PARASITES, 1908.
					Smith, Stanley	(*See* Lang, William Dickson, Smith, Stanley & Thomas, Henry Dighton).
26	I	21	5	D	Sowerby, J.	GENERA OF RECENT AND FOSSIL SHELLS, Vol. I, 1822—'34.
27	I	22	5	D	do.	do. Vol. II, 1822-'34.
28	I	23	5	D	do.	do. Vol. III, 1822-'34.
29	I	11	5	D	Subrahmanyam, T.V. Karandikar, K. R. & Murthi, N. N.	THE MARINE PELECYPODA OF BOMBAY. Reprinted from the Journal of the University of Bombay, Vol. XVII, Part 5, 1949.
30	I	26	5	D	Tate, Ralph	A PLAIN AND EASY ACCOUNT OF THE LAND AND FRESH-WATER MOLLUSKS OF GREAT BRITAIN, 1866.
					Thomas, Henry Dighton	(*See* Lang, William Dickson, Smith, Stanley & Thomas, Henry Dighton).
31	I	41	5	D	Thorrel, T.	DESCRIPTIVE CATALOGUE OF THE SPIDERS OF BURMA based upon the collection made by Oates, Eugene W., 1895.
32	I	17	5	D	Various Authors	PAPERS ON LAND AND MARINE MOLLUSCA, a bound serial.
33	I	1	5	D	Verbeek, R. D. M.	RAPPORT SUR LES MOLUQUES. Edition francaise du Jaarbock Van het Mijnwezen in Nederlandsch Oost—Indië Tome, XXXVII, 1908.
34	I	25	5	D	Vertrees, Herbert H.	PEARLS & PEARLING 1913.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
35	I	33	5	D	Warburton, Cecil	SPIDERS, the Cambridge Manuals of Science and Literature, 1912.
36	I	14	5	D	Withers, Thomas Henry	CATALOGUE OF FOSSIL CIRRIPEDIA in the Department of Geology, Vol. I—Triassic and Jurassic, British Museum (Natural History), 1928.
37	I	15	5	D	do.	CATALOGUE OF THE MACHAERIDIA (Turrilepas and its allies) in the department of Geology, British Museum (Natural History) 1926.
38	I	40	5	F	do.	CATALOGUE OF FOSSIL CIRRIPEDIA in the department of Geology (Cretaceous), Vol. II, 1935.
39	I	24	5	D	Woodward, B. B.	THE LIFE OF THE MOLLUSCA, 1913.
40	I	27	5	D	Woodward, S. P.	A MANUAL OF THE MOLLUSCA or Rudimentary treatise of recent and fossil shells, 1851-'56.
41	I	28	5	D	do.	do. 1880.
42	I	29	5	D	do.	do.
					Woodward, B. B.	(*See* Kennard, A. S. & Woodward, B. B.).

SUPPLEMENT TO PART V

I F R—*The Fauna of British India Series*; *Reference volume, not lent out.*

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
1	IFR	5	7	B	Annandale, N.	The Fauna of British India including Ceylon & Burma, Freshwater sponges, Hydroids & Polyzoa, 1911.
2	IFR	5b	7	B	do.	do.
3	IFR	10	7	B	Baylis, H. A.	do. Nematoda, (Ascaroidea & strongyloidea) Vol. 1, 1936.
4	IFR	11	7	B	do.	do. (Filarioidea, Dictophymoidea & Trichinelloidea) Vol. II, 1939.
5-6	IFR	12-13	7	B	do.	do. a duplicate set.
7	IFR	1	7	B	Bhatia, B. L.	The Fauna of British India including Ceylon & Burma, Protozoa: sporozoa, 1938.
8	IFR	2	7	B	do.	do.
9	IFR	3	7	B	do.	do. Protozoa: Ciliophora, 1936.
10	IFR	4	7	B	do.	do.
11	IFR	17	7	B	Blanford, Dr. W. T. & Godwin-Austin, Lt.-Col. H. H.	The Fauna of British India including Ceylon & Burma, Mollusca—Testacellidae & Zonitidae, 1908.
12	IFR	18	7	B	do.	do.
					Godwin-Austin, Lt.-Col. H. H.	*See* Blanford, Dr. W. T. & Godwin-Austin, Lt.-Col. H. H.
13	IFR	21	7	B	Gude, G. K.	The Fauna of British India including Ceylon & Burma, Mollusca (Trichomorphidae--Janellidae) Vol. II, 1914.
14	IFR	22	7	B	do.	do. Land Operculates (Cyclophoridae, Truncatellidae, Helicinidae) Vol. III, 1921.
15-16	IFR	23-24	7	B	do.	do. a duplicate set.
17	IFR	13	7	B	Harding, W. A. & Moore, Prof. J. Percy.	The Fauna of British India including Ceylon & Burma, Hirudinea, 1927.
18	IFR	14	7	B	do.	do.
					Moore, Prof. J. Percy	*See* Harding, W. A. & Moore, Prof. J. Percy.
19	IFR	25	7	B	Pocock, R. I.	The Fauna of British India including Ceylon and Burma, Arachnida, 1900.
20	IFR	26	7	B	do.	do.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
21	IFR	19	7	B	Preston, H. B.	The Fauna of British India including Ceylon & Burma, Mollusca (Freshwater Gastropoda & Pelecypoda), 1915.
22	IFR	20	7	B	do.	do.
23	IFR	6	7	B	Southwell, T.	The Fauna of British India including Ceylon & Burma, Cestoda, Vol. I, 1930.
24	IFR	7	7	B	do.	do. Vol. II, 1930.
25-26	IFR	8-9	7	B	do.	do. a duplicate set.
27	IFR	15	7	B	Stephenson, J.	The Fauna of British India including Ceylon & Burma, Oligochaeta, 1923.
28	IFR	16	7	B	do.	do.

PART VI—BOTANY

B—Botany
B R—Botany—Reference volume, not lent out.
B F I R—The Flora of British India series. Reference volume, not lent out.
B F B R—The Flora of Bombay series. Reference volume, not lent out.
B F M R—The Flora of Madras series. Reference volume, not lent out.
B Ag.—Agriculture.
B S—Silviculture.
B P—Pharmacopia & Medicine.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
1	B	130	10	D	Aitchison, J. E. T.	ON THE FLORA OF THE KURAM VALLEY ETC., Afghanistan (Reprinted from the Journal of the Linnean Society), Vol. XVIII, 1880.
2	B	206	11	C	Allen, Grant	THE STORY OF THE PLANTS, 1895.
3	B	161	10	E	Alston, A. H. G.	THE KANDY FLORA, 1938.
4	B	154	10	E	Astbury, W. T.	TEXTILE FIBRES UNDER THE X-RAYS.
5	B R	216	25	A	Bailey, L. H.	THE STANDARD CYCLOPEDIA OF HORTICULTURE A—E, Vol. I, 1927.
6	B R	217	25	A	do.	do. F—O, Vol. II, 1927.
7	B R	218	25	A	do.	do. P—Z, Vol. III, 1927.
8	B	4	10	A	Baillon, H.	THE NATURAL HISTORY OF PLANTS — Ranunculaceae, Dilleniaceae, Magnoliaceae Anonaceae, Monimiaceae, Rosaceae, Vol. I, 1871.
9	B	5	10	A	do.	do. Connaraceae, Legumanoceae, Proteaceae, Lauraceae, Elaeagnaceae & Myristicaceae,—Vol. II, 1872.
10	B	6	10	A	do.	do. Menispermaceae, Berberidaceae, Nymphaceae, Papavaraceae, capparidaceae, Cruciferae, Resedaceae, Crassulaceae, Saxifragaceae, Piperaceae, Urticaceae, Vol. III, 1874.
11	B	7	10	A	do.	do. Nyctaginaceae, Phytolaccaceae, Malvaceae, Tiliaceae, Dipterocarpoceae, Chlaenaceae, Ternstroemiaceae, Binaceae, Cistaceae, Violaceae, Ochnaceae, Rutaceae, Vol. IV, 1875.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
12	B	8	10	A	Baillon, H.	do. Geraniaceae, Linaceae, Tremandraceae, Polygalaceae, Vochysiaceae, Euphorbiaceae, Terebinthaceae, Sapindaceae, Malpighiaceae, Meliaceae, Vol. V, 1878.
13	B	9	10	A	do.	do. Celastraceae, Rhamnaceae, Penaeaceae, Thymelaeaceae, Ulmaceae, Castaneaceae, Combretaceae, Rhizophoraceae, Myrtaceae, Hypericaceae, Clusiaceae, Lythrariaceae, Onagrariaceae, Balanophoraceae, Vol. VI, 1880.
14	B	10	10	A	do.	do. Melastomaceae, Cornaceae, Umbelliferae, Rubiaceae, Valerianaceae, Dipsacaceae, Vol. VII, 1881.
15	B Ag	249	25	B	Barron, Archibald F.	Vines & Vine culture, Third Edition, 1892.
16	B R	21	10	A	Baynes, C. E.	Album of Indian Ferns, 1887.
17	B R	22	10	A	do.	do.
18	B Ag	188	11	C	Beccari, Dr. Odoardo	Reliquiae Schefferianae, illustrazione di alcune Palmae Viventi nel Giardino Botanico di Buitenzorg, 1885.
19	B R	290	6	B	do.	Asiatic Palms—Lepidocaryeae—The species of Calamus Part I, Annals of the Royal Botanic Gardens, Calcutta, Vol. XI, 1908.
20	B R	291	6	B	do.	do. Supplement, 1914.
21	B R	293	6	B	do.	do. Supplement Part I, Vol. XI, (Appendix), 1913.
22	B R	294	6	B	do.	do.
23	B R	295	6	B	do.	do. The species of Daemonorops, Parts I-III (Text), Annals of the Royal Botanic Gardens, Calcutta, Vol. XII, 1911.
24	B R	296	6	B	do.	do. Plates.
25	B	135	10	D	Beddome, Col. R. H.	Handbook to the Ferns of British India, Ceylon & Malay Peninsula, 1883.
26	B	140	10	D	do.	do.
27	B Ag	239	25	B	Beeton	Beeton's Illustrated Book of the Garden—the theory and practice of garden in all its branches, 1889.
28	B	49	10	B	Benthall, A. P.	The Trees of Calcutta and its neighbourhood, 1946.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
29	B	95	10	C	Bibby, Cyril	Simple Experiments in Biology, 1944.
30	B	167	10	E	Birdwood, George	Catalogue of the Economic Products of the Presidency of Bombay—being a catalogue of the Government Central Museum, Division I.—Raw produce (vegetable), 1862.
31	B	168	10	E	do.	do.
32	B	139	10	D	Birdwood, G. C. M.	Catalogue of the Vegetable productions of the Presidency of Bombay; including a list of the drugs sold in the Bazaars of Western India, 2nd Edition 1865.
33	B	50	10	B	Birdwood, H. M.	A Catalogue of the Flora of Matheran & Mahableshwar (Revised Edition), 1897.
34	B R	297	6	B	Biswas, Dr. K.	The 150th Anniversary volume of the Royal Botanic Garden, Calcutta, Parts I & II, 1942.
35	B S	252	25	B	Blake, Ernest G.	The Seasoning & Preservation of Timber, being a treatise on the various methods employed for drying and preserving timber against decay with a chapter on the origin and the spread of the dry rot and the best methods to be adopted for its eradication, 1924.
36	B	174	10	E	Blanchan, Neltje	Wild Flowers—The Nature Library, 1926.
37	B R	17	10	A	Blatter, The late Rev. E. & Millard, Walter S.	Some Beautiful Indian Trees, 1937.
38	B	144	10	D	Blatter, Ethelbert	Plant Types for College students, 1917.
39	B	89	10	C	Blatter, E. & D'Almeida, J. F.	The Ferns of Bombay, 1922.
40	B R	19	10	A	Blatter, Ethelbert	The Palms of British India & Ceylon, 1926.
41	B R	34	10	A	Blatter, S. J. Ethelbert	Beautiful Flowers of Kashmir, Vo. I, 1928.
42	B R	35	10	A	do.	do. Vol. II, 1928.
43	B	73	10	B	Blatter, E. McCann, C. & Sabnis, J. S.	The Flora of the Indus Delta, 1929.
44	B	148	10	E	Blatter, E. & McCann, C.	The Bombay Grasses—Scientific Monograph No. 5—The Imperial council of Agricultural Research, 1935.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
45	B R	47		Mus	Blatter, The late Rev. E. & Millard, Walter S.	SOME BEAUTIFUL INDIAN TREES, 1937.
46	B	105	10	C	Bose, Sir Jagdis Chunder	LIFE MOVEMENTS IN PLANTS—TRANSACTIONS OF the Bose Research Institute, Calcutta, Vol. I, pts. 1 & 2, 1918.
47	B	105*a*	10	C	do.	do. Vol. II, 1919.
48	B	122	10	D	Bower, F. O.	PLANTS & MAN—a series of essays relating to the Botany of ordinary life, 1925.
49	B	116	10	D	Brandis, Dietrich	INDIAN TREES—an account of trees, shrubs, woody climbers, Bamboo and Palms indigenous or commonly cultivated in the British Indian Empire, 1906.
50	B R	153	10	E	do.	ILLUSTRATIONS OF THE FOREST FLORA OF NORTHWEST AND CENTRAL INDIA, 1874.
51	B	131	10	D	Burkill, I. H.	A WORKING LIST OF THE FLOWERING PLANTS OF BALUCHISTAN, 1909.
52	B	169	10	E	Burns, W.	FIRMINGER'S MANUAL OF GARDENING FOR INDIA, 6th Edition (Revised & Edited), 1918.
					Caccia, A. M. F.	*See* D'Arcy, W. E. & Caccia, A. M. E.
53	B	114	10	D	Cain, Stanley A.	FOUNDATIONS OF PLANT GEOGRAPHY, 1944.
54	B A G	247	25	B	Cameron, J.	FIRMINGER'S MANUAL OF GARDENING FOR INDIA, 5th Edition, 1904.
55	B	132	10	D	Carey, M. C. & Fitchew, Dorothy	WILD FLOWERS AT A GLANCE, 1949.
56	B	155	10	E	Champion, H. G.	SILVICULTURAL MANUAL for use in India (The experimental manual), general Vol. I, 1931.
57	B	156	10	E	Champion, H. G. & Mahendru, I. D.	do. Statistical Research (the statistical code), Vol. II, 1931.
58	B R	15	10	A	Champion, H. G.	A PRELIMINARY SURVEY OF THE FOREST TYPES OF INDIA & BURMA—Indian Forest Records—(New Series) Silviculture, Vol. I, No. 1. 1936.
59	B	84	10	C	Cheeseman, T. F.	MANUAL OF THE NEW ZEALAND FLORA, 1906.
60	B	102	10	C	Cheyney, E. G.	WHAT TREE IS THAT? 1927.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
61	B R	287	6	B	Clarke, C. B.	COMMELYNACEAE ET CYRTANDRACEAE BENGALENSES (Paucis Aliis Ex Terris Adjacentibus Additis), 1874.
62	B	97	10	C	Cockayne, L.	NEW ZEALAND PLANTS and their story, 1910.
63	B Ag	203	11	C	Coit, J. Eliot	CITRUS FRUITS—an account of the citrus fruit industry with special reference to California requirements and practices and similar conditions, 1920.
64	B	87	10	C	Cole, Rex Vicat	THE ARTISTIC ANATOMY OF TREES—their structure and treatment in painting, 1925.
65	B	70	10	B	Collett, Col. Sir Henry	FLORA SIMLENSIS, a handbook of the flowering plants of Simla and neighbourhood, 1921.
66	B	74	10	B	Colthurst, Ida	FAMILIAR FLOWERING TREES IN INDIA, 1924.
67	BFBR	36	10	B	Cooke, Theodore	THE FLORA OF THE PRESIDENCY OF BOMBAY Vol. I, Part I (Ranunculaceae—Rutaceae), 1901.
68	BFBR	37	10	B	do.	do. Part II (Simarubaceae—Legumanoceae), 1902.
69	BFBR	38	10	B	do.	do. Part III (Legumanoceae contd.—Rubiaceae), 1903.
70	BFBR	39	10	B	do.	do. Vol. II, Part I (Compositeae — Boraginaceae), 1904.
71	BFBR	40	10	B	do.	do. Part II (Boraginaceae contd.—Verbenaceae), 1905.
72	BFBR	41	10	B	do.	do. Part III (Verbenaceae contd.—Euphorbiaceae), 1906.
73	BFBR	42	10	B	do.	do.-Part IV (Euphorbiaceae contd.—Araceae), 1907.
74	BFBR	43	10	B	do.	do. Part V, (Araceae contd. —Graminae with Index), 1908.
75	BFBR	44	Mus	B	do.	do. Vol. I (Ranunculaceae —Rubiaceae), 1901-1903. (in a single volume).
76	BFBR	45		Mus	do.	do. Vol. II (Compositeae—Graminae), 1904-1907. (in a single volume).
77	B Ag	244	25	B	Corrie, Frank Ewart	MANURES & MANURING—a handbook for practical farmers, students and others, 1927.
78	B Ag	273	25	C	do.	LIME IN AGRICULTURE—a handbook for practical farmers, students and others, 1926.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
79	B R	46		Mus	Cowen, D. V.	Flowering Trees & Shrubs in India, 1950.
80	B R	14	10	A	Curtis, Chartes H.	Orchids for Everyone, 1910.
81	B Ag	89	11	C	Duthie, J. F.	The Fodder Grasses of Northern India, 1888.
82	B	96	10	C	Daglish, E. Fitch	Marvels of Plant Life, 1924.
					D'Almeida, J. F.	*See* Blatter, E. & D'Almedia, J. F.
83	B	92	10	C	Dalgado, Dr. D. G.	Flora de Goa e Savantvadi, 1898.
84	B S	183	11	C	D'Arcy, W. E. & Cacia, A. M. F.	Preparation of Forest working-plans in India, 4th Edition, 1910.
85	B	65	10	B	Dalzell, Nicholas A. & Gibson, Alexander	The Bombay Flora or Short Descriptions of all the indigenous plants hitherto discovered in or near the Bombay Presidency together with a supplement of introduced and naturalized species, 1861.
86	B	66	10	B	do.	do.
87	B	133	10	D	Darwin, Charles	The Variation of Animals & Plants under domestication, Vol. II, 1868.
88	B	142	10	D	do.	The Various Contrivances by which Orchids are fertilized by Insects, 2nd Edition, 1885.
89	B Ag	191	11	C	Davis, R. A.	Citrus growing in South Africa, 1924.
90	B Ag	248	25	C	Davis, Kary C.	Horticulture Enterprises, 1929.
91	B	196	11	C	Detmer, Dr. W.	Lehrbuch der Pflsnzenphysiologie, 1883.
92	B P	106	10	C	Dhargalker, Lakshman B.	Notes on the Therapeutics of Indigenous Vegetable drugs, 1st Edition, 1899.
93	B	104	10	C	Drury Maj. Heber	The Useful Plants of India alphabetically arranged with botanical descriptions, vernacular synonyms and notices of their economical value in commerce, medicine and the Arts, 1858.
94	B R	30	10	A	Duthie, J. F.	Illustrations of the Indigenous Fodder Grasses of the plains of North-western India, 1886.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
95	B Ag	180	11	C	Duthie, J. F. & Fuller, J. B.	Field and Garden Crops of North-Western Provinces & Oudh, with illustrations—Department of Agriculture & Commerce—N.W. Provinces & Oudh, Part I, 1882.
					Duthie, J. F.	*See* Strachey, Lt.-Genl. Sir Richard & Duthie, J. F.
96	B P	275	11	C	Dymock, William Warden, C.J.H. & Hooper, David	Pharmacographia indica—a history of the principal drugs of vegetable origin met with in British India, Vol. I, 1890.
97	B P	276	11	C	do.	do. Vol. II, 1891.
98	B P	277	11	C	do.	do. Vol. III, 1892.
99	B Ag	269	25	C	Eisen, Gustav	The Fig: its history, culture and curing with a descriptive catalogue of the known varieties of figs—U.S. Department of Agriculture Bulletin No. 9, 1901.
100	B Ag	270	25	C	Eisen, Gustav	do.
101	B	20	10	A	Exell, Arthur Wallis	Catalogue of the Vascular Plants of S. Tome' (with principe and annobon) British Museum (Natural History), 1944.
102	B	125	10	D	Fawcett, W.	The Banana—its cultivation, distribution and commercial uses, 2nd Edition (enlarged), 1921.
103	B	101	10	C	Firminger, Thomas A. C.	A Manual of Gardening for Bengal & Upper India, 3rd Edition, 1824.
					Fitchew, Dorothy	*See* Carey, M. C. & Fitchew, Dorothy.
104	B	141	10	D	Fletcher, S. W.	Straw-berry growing, the rural science series (edited by Bailey, L. H.), 1917.
105	B	231	25	B	Freeman-Mitford, A. B.	The Bamboo Garden, 1896.
					Fuller, J. B.	*See* Duthie, J. F. & Fuller, J. B.
106	B	115	10	D	Gamble, J. S.	A Manual of Indian Timbers—an account of the structure, growth distribution and quantities of Indian woods, 1881.
107	BFMR	61	10	B	do.	Flora of the Presidency of Madras, Vol. I, 1915
108	BFMR	62	10	B	do.	do. Vol. II, 1923.
109	BFMR	63	10	B	do.	do. Vol. III, 1931.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
110	B R	145	10	E	'Garden, The'	HORTICULTURAL ILLUSTRATIONS, Vol. I, 1890-1899.
111	B R	146	10	E	do.	do. Vol. II, do.
112	B R	147	10	E	do.	do. Vol. III, do.
113	B	194	11	C	Giboin, Lucien M.	EPITOME' DE BOTANIQUE ET DE MATIÉRE Médicale de L'inde et spécialement Des Establishment Francais Dans L'inde—Thése, 1949.
114	B	195	11	C	do.	do.
115	B	113	10	D	Good, Ronald	THE GEOGRAPHY OF THE FLOWERING PLANTS, 1947.
116	B Ag	240	25	B	Gould, H. P.	PEACH-GROWING, 1918.
117	B	64	10	B	Grant, Capt. Bartle	THE ORCHIDS OF BURMA (including Andaman Islands) Described, 1895.
118	B	94	10	C	Greaves, Joseph E. & Greaves, Ethelyn O.	BACTERIA IN RELATION TO SOIL FERTILITY, 1926.
119	B	157	10	E	Government Publication	A MANUAL OF FOREST LAW.—compiled for the use of the students at the Imperial Forest College, Dehra Dun, 1906.
120	B S	190	11	C	Government of India	A CONCISE MANUAL OF SYLVICULTURE for the use of the Forestry students in India, 1906.
121	B	201	11	C	Government of India	AGRICULTURE IN INDIA—The Publications division, Ministry of Information & Broadcasting Government of India, Delhi, 1950.
122	B	90	10	C	Graham, John	A CATALOGUE OF THE PLANTS GROWING IN BOMBAY AND ITS VICINITY; spontaneous, cultivated or introduced, as far as they have been ascertained, 1839.
123	B R	278	6	A	Griffith, William & M'Clelland, John	PALMS OF BRITISH EAST INDIA, 1850.
					Greaves, Ethelyn O.	*See* Greaves, Joseph E. & Greaves, Ethelyn O.
124	B	205	11	C	Haines, H. H.	A FOREST FLORA OF CHOTA NAGPUR including Gangpur and the Santalparganahs—a description of all the indigenous trees, shrubs and climbers, the principal economic herbs and the most commonly cultivated trees and shrubs, 1910.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
125	B	207	11	C	Haines, H. H.	DESCRIPTIVE LIST OF TREES, SHRUBS AND ECONOMIC HERBS of the Southern Circle, Central Provinces, 1916.
126	B	86	10	C	Harler, Agnes W.	THE GARDEN IN THE PLAINS, 3rd Edition, 1948.
					Haskell, Sidney B.	*See* Voorhees, Edward B. & Haskell, Sidney B.
127	B Ag	238	25	B	Head, Brandon	THE FOOD OF THE GODS, a popular account of Cocoa, 1903.
128	B Ag	233	25	B	Hedrick, U. P.	MANUAL OF AMERICAN GRAPE-GROWING, 1919.
129	B	72	10	B	Heinig, R. L.	GLOSSARY OF THE BOTANIC TERMS USED IN DESCRIBING FLOWERING PLANTS, 1899.
130	B	138	10	D	Hibberd, Shirley	THE AMATEUR'S KITCHEN GARDEN—a handy guide to the formation and management of the kitchen garden and the cultivation of useful vegetables and fruits.
					Hibberd, Shirley	*See* Hulme, F. Edward & Hibberd, Shirley
131	B	229	25	B	do.	NEW & RARE BEAUTIFUL LEAVED PLANTS; containing illustrations and descriptions of the most ornamental-foliaged Plants, 1870.
					Hillhouse, W.	*See* Strasburger, Dr. E. & Hillhouse, W.
132	B	120	10	D	Hole, R. S.	A MANUAL OF BOTANY FOR INDIAN STUDENTS, 1909.
					Holland, John Henry	*See* Nicholls, Sir Henry Alford & Holland, John Henry.
133	BFIR	52	10	B	Hooker, Sir J. D.	THE FLORA OF BRITISH INDIA, Vol. I (Ranunculaceae—sapindaceae), 1872.
134	BFIR	53	10	B	do.	do. Vol. II (Sabiaceae-Cornaceae), 1882.
135	BFIR	54	10	B	do.	do. Vol. III (Caprifoliaceae-Apocynaceae), 1879.
136	BFIR	55	10	B	do.	do. Vol. IV (Asclepediaceae—Amarantaceae), 1885.
137	BFIR	56	10	B	Hooker, Sir J. D.	THE FLORA OF BRITISH INDIA, Vol. V (Chenopodiaceae — Orchideae), 1890.
138	BFIR	57	10	B	do.	do. Vol. VI (Orchideae contd.—cyperaceae), 1894.

Serial No.	Classification	Accession No.	Cabinet	Shelf	Author	Title of Book
139	BFIR	58	10	B	Hooker, J. D.	The Flora of British India, (Cyperaceae contd., Gramineae & General Index), 1897.
140	B R	286	6	B	do.	Illustrations of Himalayan Plants, 1855.
					Hooper, David	*See* Dymock, William Warden C. J. H. & Hooper, David
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					Howard, Gabrielle L. C.	*See* Howard, Albert & Howard, Gabrielle L. C.
142	B	124	10	D	Hughes-Gibb, Eleanor	Trees and Men, 1938.
143	B	261	25	B	Hulme, F. Edward & Hibberd, Shirley	Familiar Garden Flowers—first series.
144	B	262	25	B	do.	do. second series.
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155	B	60	10	B	do.	do. II Monocotyledons, 1934.
156	B	158	10	E	Jacquot, A.	Incendies en Forêt (Forest Fires) (Translated by Fisher, C. E. C.), 1910.
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					Lister, Gulielma	*See* Lister, Arthur & Lister, Gulielma.
171	B	182	11	C	Lloyd, C. G.	Index of the Mycological writings Vol. VI, 1920-1921.
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173	B R	27	10	A	Lowis, Lena	Familiar Indian Flowers with coloured plates, 1878.
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182	B	25	10	A	do.	do. Vol. III (parts 21-30), 1908.
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					Warden, C. J. H.	*See* Dymock, William Warden, C. J. H. & Hooper, David
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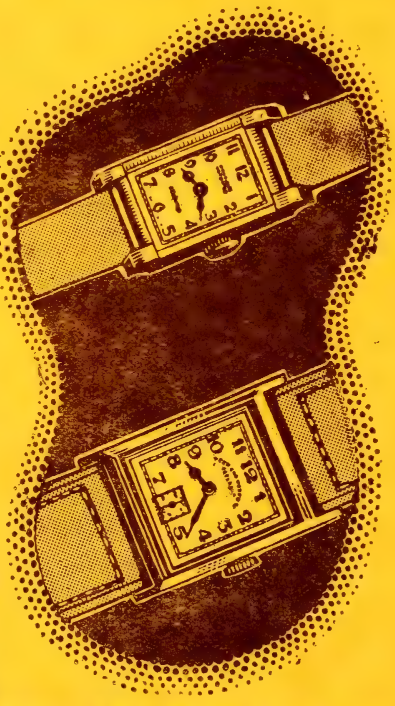

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JOURNAL
OF THE
BOMBAY NATURAL HISTORY SOCIETY

1951 Vol. 50 No. 2

JUNGLE MEMORIES

BY

Lt.-Col. E. G. Phythian-Adams, O.B.E., F.Z.S., I.A. (Retd.)

Part X—Mixed Bag

(*With two plates*)

(*Continued from p. 12 of this Volume*)

Pig

Few opportunities for pig-sticking have come my way, as I was never stationed in Bengal, and outside that province the country, vast though it is, with few exceptions does not lend itself to that grand form of sport. My memories of pig are therefore chiefly of those encountered in the jungle and shot as food for the men. Not that anyone uninhibited by religion need turn up his nose at a pigling or even a young sow, provided it is shot far from any village. In this connection I remember one bagged in Chanda in 1907. I jokingly asked my Gond shikari whether he would eat it, and he replied that of course everyone ate pork. When I pointed out that Muhammedans did not, the reason he gave startled me. Perhaps I had better not quote it, though my Muhammedan butler merely remarked that the shikari was an ignorant old man, when I told him.

Most of my pigs have been bagged in the Nilgiris and some of the forest boars I have met were immense brutes with tushes running up to 9½ inches. Only once have I shot a ten incher and that was at Bison Swamp during Christmas 1927. We saw him while marching out to camp but failed to contact. Next morning we came across him again while making our way to a lookout spot soon after dawn. He was quite close, but by the time I had snatched the sight-protector off the rifle and loaded a cartridge from the magazine (I should have done all this before setting out), he was well away up the hill. I fired two shots both of which I was sure had found their mark, but he still carried on. I was about to fire again when he staggered and fell, kicked a bit and then rolled downhill dead. One bullet had pierced through shoulder and heart, the other was far back and had come out of the stomach. He was one of the biggest boars I have seen, and my shikari 'Old' Anthony estimated his age at 20 years. Height at shoulder was 36 inches, length of body (excluding tail) 5 ft. 3 inches, and girth of neck tight behind the ears 29 inches, while the tushes taped the full 10 inches. The men had some difficulty in eating him, he was so tough. Another boar shot near Hodgson's Hut was remarkable for having one hind leg missing. He was beaten out of a *shola*, and I did not realise that he was in any way maimed until I had rolled him over. Presumably the lower part of the leg had been shattered by a bullet and had sloughed off; the wound had healed completely and gave that leg the appearance of a ham. I have known a similar case with a tigress, which came out of a beat at full gallop and showed no sign of injury. Yet another boar was bagged under rather unusual circumstances near the Toda Cathedral. We were beating a *shola* for small game, when the shikari came out and told me there was a pig lying up in a thicket which refused to move. I had no rifle with me that day, so loaded my 12 bore with Lethals and approached the spot, but the bushes were so dense that I could see nothing. Finally I wormed my way in at full length along the ground, and at last saw the animal only 5 yards off. A lucky bullet killed it, and when the beaters hacked their way in and dragged it out, I discovered how foolhardy I had been, for instead of the half grown pig I expected, it proved to be a big boar with 9½ inch tushes. What possessed him to lie so low I cannot imagine, as he was not in any way injured. It was lucky for me that he did not prove aggressive or I should have been for it properly. Two other boars I remember at which I did not fire though both were close shots. One was while I was working the country from Masnigudi towards the foot of the hills. We spotted a sounder of about 20 pig some 300 yards away and went after them. As we reached the bottom of a deep nullah which lay between, I saw an old boar 20 feet above looking down at us. It is a sound rule not to fire at a dangerous animal above one, so I stood still and waited for him to make the first move. I have never known pig to be aggressive unless wounded, and this one proved no exception, for after a good stare at us he turned and trotted off. The other was encountered near Mudumalai while after chital. We were working up to a good buck, when suddenly an old boar passed between us and the deer. He spotted us, had a good look and then moved a few yards towards us. I did not want to fire as it would have spoilt our chance at the buck, but the range was getting desperately close and I thought I should have to do so, when he decided that we were harmless and cleared off. That was the only time when I have seen a pig uncertain whether to attack or not. Following up a wounded boar is a far more dangerous undertaking than in the case of tiger or panther, for nothing but death will stop his charge and one slash from those razor sharp tushes can disembowel a man or sever the femoral artery. A pig-sticking friend advised me that when down with the boar standing over one, the only thing to do was to lie flat on one's face with both hands held tightly round the back of the neck. In this way the vitals are covered and if a man remains motionless, the chances are, he said, that the boar will be content with a few slashes on the back and then leave him. I am glad to say I have never had to try this, but pass on the tip in case it may be useful in such an emergency.

Pigs give excellent practice with the rifle and many are the beats I have had for them on the slopes round my home in recent years. They are so destructive to the crops that the villagers are only too glad to turn out for the purpose, and they also much appreciate the meat. Shots are seldom under 100 yards and nearly always running ones, but these present little difficulty if one remembers to give the animal a slight lead and to keep the rifle swinging until after the trigger has been pressed. The most convenient position for such shots is sitting, and the rifle I use for this purpose is my .318. A pig's sense of smell is extremely acute, and the greatest attention must be paid to the direction of the wind. Their small brain might lead one to think that they are stupid animals, but on the contrary they are extremely wide-awake, and if a gun is not well concealed in a beat they will almost certainly break out to one side. Nor will they tolerate an electric light flashed on them at night, so sitting up for them over a waste butter-milk pit, as at Anaikatti, is best confined to the period round about full moon. Their food tastes are catholic. I have known pigs return again and again to the carcass of an elephant, and have found two snakes in the stomach of a huge sow shot at Anaikatti in 1947, but as a general rule they feed on roots, tubers etc., routing about for which leaves traces which will be evident to the observant shikari. On the Nilgiris plateau they do great damage to the potatoes which form the main crop of the district, and at one time Government used to pay a reward of Rs. 5 on each wild pig killed. This has unfortunately now been stopped owing to lack of funds, but the meat sells so well in these days as generally to cover the cost of beating, and as I said above they afford excellent practice with the rifle. So with average luck quite a lot of fun can be had at little expense, and no excuse is needed for shooting pig on ground where they cannot be ridden.

The tushes make up into handsome miniature trophies, one of the most useful I have seen being a pair mounted upright on an ebony plinth with a small silver table gong suspended between. When extracting them it should be remembered that some two-thirds are hidden in the skull. If the latter is boiled, the tushes can be removed without difficulty, but any attempt to cut them out is almost certain to result in their being damaged. During intense hot weather tushes are sometimes liable to flake, as happens also with tiger's teeth. This can be prevented by a thin coating of bees-wax.

CROCODILES

My earliest memory of crocodiles is of those in the pit at Mugger Pir some miles outside Karachi in 1905. They were packed so tightly that a sporting midshipman was said to have run across over their backs some years before. The pit was enclosed by a low wall, so I climbed down and took some photos at close range. I was careful to keep well clear of the heads of those lying on the mud, not realising that the tail end is the danger spot, for with one sweep of it a crocodile can knock a man or animal off his feet into the water, to be dealt with before he can recover. However, these particular brutes were so lethargic that they let me approach within a few feet without showing the least interest. Not long after my shikari persuaded me to try for one, reported to be very large, in one of the pools of the Habb river. I was well hidden in some tamarisks while the shikari tied up a goat on the opposite bank. The goat called well but nothing materialised, and after an hour or so I gave it up as a bad job. I was young and inexperienced in those days and thought the shikari was stringing me, but really I believe it is possible to get a shot in this manner.

Many years later I shot a number in the Mysore rivers and up the backwaters round Cannanore, and soon found how extremely accurate one has to be to bring one to bag. If shooting down, as for example into a pond at close range, a bullet through the brain will do the trick, but usually it is a question of stalking one lying asleep on a sandbank, and it is very seldom indeed that one can get within 100 yards without being spotted. A bullet through the heart merely results in the crocodile reaching the water and being lost; for they will not float for 24 hours and by that time the skin is ruined. The only certain shot to anchor one on the spot is through the middle of the neck, and to secure the extreme accuracy needed on such a small target a telescopic sight is invaluable. Sometimes a wounded crocodile will, after a short time, return to the land either because water has got into his lungs or from annoyance caused by fish nibbling at the wound. So if it is not killed on the spot, it is as well to take up a position under cover and watch for half an hour or so. Generally it will be time wasted, but occasionally one gets a second chance in this way.

Crocodiles are uninteresting brutes, and though I have shot a good many I have kept no details, but so far as I recollect none have been over 10 feet, not to be compared with the monsters of the Ganges. Except in the case of very small ones when the back may be utilised, the only part of the skin which is worth keeping is that from the belly, so the cuts should be made round the sides and not down the central line as in the case of other animals. The way in which the muscles twitch while the skin is being removed is apt to be disconcerting at first. Common bazaar salt, finely powdered, is the best preservative, and it should be well rubbed in after all flesh and fat has been scraped off. The sooner the skin is then despatched to the curers the better. The Chrome Leather Co. (Chromepet P.O., S. India) have turned out very good work for me, and I can recommend them. The cured skins can be made up into a number of useful articles e.g. handbags, note-cases, bedroom slippers, suitcases, etc. But in my experience they are not suitable for ladies' shoes as they tend to split.

SNAKES

Memories of the jungle would be incomplete without some mention of snakes, and I certainly have come across a fair number during so many years in India. One of my earliest experiences was at Kamptee in 1905. Eggs had been disappearing mysteriously from the Mess fowl house. The culprit proved to be a large cobra which one day stayed too late and paid forfeit. I well remember the snake zigzagging down the drive pursued by several irate sepoys armed with long bamboos, which proved less effective than my swagger cane. Kamptee with its thatched bungalows was a bad place for snakes, and one of our officers had a lucky escape when a krait fell from the ceiling cloth on to him while he was reading a paper, stretched out at ease with his legs up in a long chair.

Then there was an immense python at Bhamo, whose wide track I saw in the mud on several occasions. It was credibly reported to be in the habit of taking mules at night from the Chinese caravans encamped near the steamer ghat and the men complained to me bitterly about it. I was always hoping to come across it, but never did. I remember that one evening just before we left Bhamo two of my recruits came running in with the news that they had seen it devouring a half grown buffalo in the jungle near the rifle range. I hurried off with them, taking both gun and rifle as I was not sure which might be required, but they were unable to locate the spot again before dark, and so I lost my chance, and my only memory of 'Rupert' as we called him, is of his immense track in the mud. Judging by that he must have been well over 20 feet long. I found another large python lying dead in a swamp near Doddakatti in May 1929. Its head had been based in, and by it lay a doe jungle-sheep which it had evidently disgorged. It measured 15 feet and was little damaged though several vultures were in attendance; the skin was unfortunately too far gone to be worth taking. I have come across a number of pythons at other times in the Nilgiris, but this was the biggest I have seen. A curious incident in connection with these snakes occurred while I was in camp at Anaikatti during Xmas 1936. My shikari Banta who had gone towards Sirur to tie up a young buffalo for tiger, returned after dark with a 7 foot python. It had been knocked on the head and appeared to be dead, so I left it in the verandah of the forest bungalow, intending to skin it later. Shortly after, while I was having dinner, I heard a weird groaning noise which I thought at first was a buffalo being killed by a tiger some distance away. But it continued, so I went out and found it was made by the snake. It was still tied up and showed no other signs of life, but presumably had not been hit sufficiently hard on the head. This is the only occasion on which I have ever heard a snake make any kind of sound other than a hiss.

The handsome black and yellow Banded Krait running up to 4 feet or more, was common at Meiktila, and quite a number were killed while I was stationed there in 1920-21. The bungalows were situated round the edge of the lake, and often when motoring over to Mess in the evening I drove the car over snakes crossing the road on their way down to the water, but it seemed not to have the least effect. Russell's Vipers were common in the Anaikatti-Masnigudi area in the old days, but seem less so now that the prickly pear has been so drastically reduced by the very ill-advised introduction of the cochineal insect. Not that I regret the absence of snakes! It is the lack of nesting cover for game birds which is so deplorable. I remember one morning many years ago I was working the jungle towards Westbury, when over a bush I saw a bird's wing fluttering near the ground. On going closer I found that a Russell's Viper had a quail in its mouth with one wing still beating. A charge of shot blew both snake's head and quail to pieces. The Russell's Viper is commonly supposed to be a sluggish snake, but it can move like lightning when it wants to. One morning in October 1929 near Anaikatti we were following a path through dense prickly pear, when my shikari Jaora who was leading, nearly stepped on one. As he jumped to avoid it, the snake seemed to rise on end and threw itself backwards into cover, and was gone like a flash. I had no idea that they can move so quickly, but there was no doubt about identification, as I was following next and had a clear view at very close range. These vipers have a nasty habit of lying on pads of floating weed near the edge of a tank, where bulrushes afford shade and at the same time protection from birds of prey. More than once while wading after duck near Gundlupet I have nearly bumped into them in this way, but a loud hiss has always warned me in time. Whether they can strike effectively in this position, I do not know, but I should not care to experiment!

Of Hamadryads I have one memory only. During the last war I was motoring down the Mettupalaiyam ghat early one morning, and a mile or two before reaching the bottom saw a large snake cross the road 50 yards ahead and climb up on to the berm at the side. As we drew level it sat up and spread its hood, and it was not till then that I realised what it was. A good 15 feet long and shining jet black, it looked like an animated steel bar, and gave the impression of tremendous power. I could not help thinking what utter nonsense it is to imagine, as some people apparently do, that such a thick set massive brute can be killed with a cane. Nothing short of an iron rod would have the least effect! And how grand he looked compared with those captives from Mount Popa which I had previously seen on show at Meiktila. As different as a wild tiger from one in a zoo. Even if I had had a gun with me I do not think I could have brought myself to shoot him. That I should have encountered only one hamadryad during so many years wandering in the jungle, often in parts where they were reported to exist, goes to show how uncommon they really are. I suspect that in many cases reported, large cobras are mistaken for them. No one could possibly fail to recognise the real article, it is simply terrific.

Ratsnakes are among the commonest in India. They do such good work killing other snakes that I never destroy one nowadays. But I would gladly have put a charge of shot into one near Poona many years ago. I was shooting snipe round the edge of the Khadakvasla lake, and dropped a bird very close to, if not actually on the top of a large ratsnake lying out unseen in the short grass some 30 yards ahead. Such a gift was as welcome as it was unexpected. The snake seized the bird and was gone down a hole before I realised what was happening. Another ratsnake I remember shooting at Bhamo, mistaking it for a cobra. A Burman working nearby asked if he might have it, so I handed it over. When I asked what he intended to do with it, he replied 'To eat it'. There certainly is no accounting for tastes!

A little drama I witnessed in 1945 some miles out of Mangalore remains in my memory. I had finished lunch and was sitting quietly by the roadside, when in the ditch just below me I saw a green grass snake also looking for his tiffin. He came quietly along nosing under the overhanging grass and ferns till presently he put up a frog. With a couple of jumps the latter got away, but the ditch ended, and seeing he was cornered the frog leaped back right over the snake. I thought the latter had lost his chance, but he was round in a flash, and in two bounds had caught the frog and went off with it. He deserved his success and I did not disturb him.

Snake skins can be made up into handsome articles. They should be taken off as soon as possible after death, and will come off easier so. Pounded salt, as with crocodile skins, is the best preservative.

BEES

While wandering through the jungle one may have the luck to come across a hollow tree in which bees have their hive. If time permits, it is worth while stopping to take the honey, which is excellent. My first experience of this was in June 1909 while I was in North Kanara after bison. My men spotted bees coming out of a fallen tree and cut out the comb, which weighed about 3 lb. They said that particular kind of bees did not sting, but I noticed that they took the honey some 20 yards away, when all the bees left them. I kept a piece of comb for myself and the rest was eaten by the shikari and tracker on the spot. They squeezed out the honey into leaf cups, and then dipped into it pieces of comb containing the live grubs. I suppose it was that which made the incident stick in my memory. Rather like the Chinese delicacy of baby white mice also dipped in honey! Those were the small jungle bees; the large rock bees are quite a different proposition.

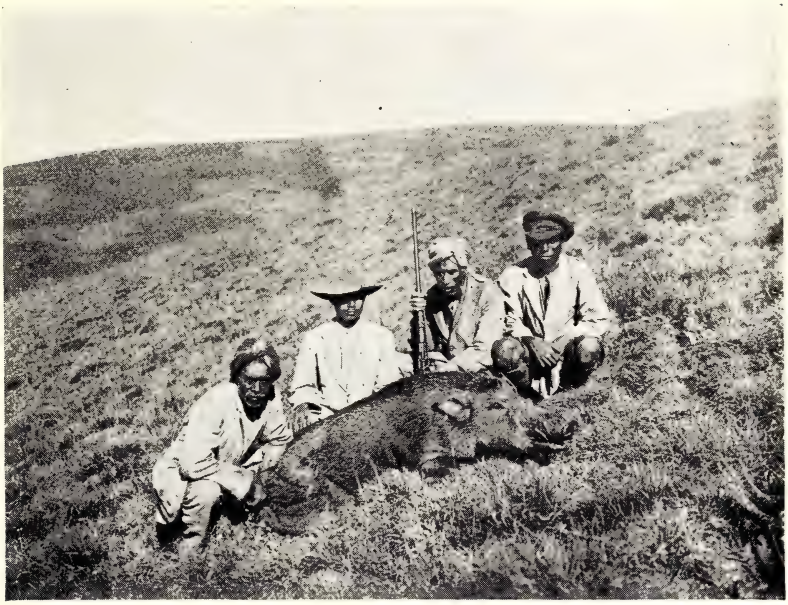
Their huge dark brown combs, suspended from the branch of a lofty tree or from an overhanging rock are a common sight. But it is not everyone who realises how dangerous these brutes can be. So long as they are undisturbed, all is well, but the sound of a shot near at hand, the smoke from a camp fire, or even the odour of tobacco will at times enrage them and bring them down in their hundreds, with disastrous, if not fatal, results. I remember that while I was stationed at Kamptee in 1906, the Field Artillery battery out exercising one day passed under a tree having several huge nests. The rumble of the wheels on the hard highway disturbed the bees, and down they came. The horses became uncontrollable, and while some teams galloped towards cantonments, others broke away across country. Luckily there were no fatal casualties but it was some time before the battery could reassemble. In 'Birds of Southern India' Col. Baker relates how a Honey Buzzard striking at a comb in the centre of Ootacamund infuriated the bees, and created a panic among passers-by, some of whom were badly stung. And as recently as November 1950 a similar occurrence in Coonoor resulted in the death of an old woman.

I had a very unpleasant experience with them myself while living in Mysore in 1932. I had gone out one morning to the big Arsinakere tank some 4 miles beyond Nanjangud, to try and pick up a few duck, and on arrival saw that there were a number of pintails within range of a small bush-covered mound. I stalked them and laid out a couple, and was on the point of going to pick them up, when 'Little Boy', (who was as good at retrieving duck as he was at following up a tiger), rushed past me with his black coat literally covered with bees. The next second more were on to me. I dropped my gun, and did what must have been the record quarter mile for Mysore, but could not throw them off. Matters were getting serious, but luckily I remembered a tip I had been given many years before by an old shikari. I tore off my coat, wrapped it round my head, and lay motionless on the ground. I could hear the angry hum of hundreds of bees as they crawled over my coat, but they soon left, and I was able to get up in time to see G. take to the water. He was unaware what had happened, but realised that something was wrong, so was running to my assistance when he also was attacked. We were lucky to get away with it. I had 17 stings on my face and neck, besides others on my hands and arms, and the dog also was severely stung, but G. got off fairly lightly. Remained now to recover my gun, and I wondered how on earth we could manage it, when a villager came by who volunteered to do so. Plucking some wild garlic and waving it round his head, he returned without a single sting; a tip worth knowing if you can recognise the plant. Revisiting the spot at a later date, I found that the front side of the bush covered mound I have mentioned had been quarried for stone, and the bees had a comb there. Whether it was my shot or the dog routing about in the bushes which disturbed them, I am unable to say, but certainly the result was sufficiently unpleasant. I look back on that affair as one of the narrowest squeaks I have had.

The large yellow wasps are nothing like so dangerous, at least in my experience. Their round *papier-mache* nests, suspended from a low branch are familiar to most people. Near Secunderabad I ran full tilt into one while chasing a winged partridge. I received several stings before I could get clear, but the results were negligible as compared with rock bees.

CLOSE QUARTERS WITH A PANTHER

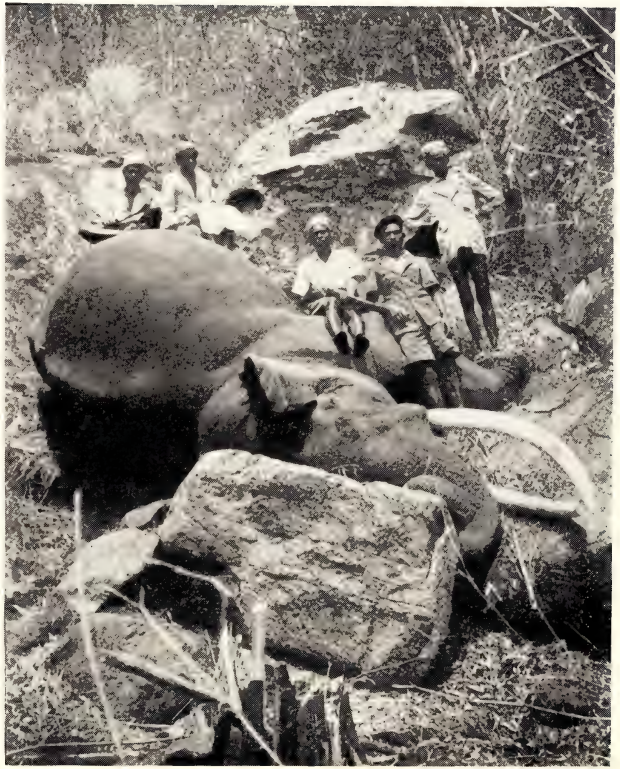
While writing the section on panthers, I could not help reflecting that in the course of so many years, I had been extremely fortunate to have experienced no untoward incident with these animals. It is true that, so far as possible, I have made a point of not firing at



The Bison Swamp Boar.

Photos Author

Scene of panther incident.



Photos — Author

With Thibaw's elephants at Bhamo.

My last tusker.

any animal until reasonably certain of inflicting a mortal wound with the first shot. That, I suppose, coupled with luck, was the reason why I had come off so well. But the old adage that accidents will happen in the best regulated families, was forcibly brought home to me on the 29th December 1950, when I had an experience which I am not likely to forget.

With two other guns I had gone down to Anaikatti at the foot of the northern slopes of the Nilgiris for a small game shoot. During the morning we had a number of beats over the open country, with a view to driving such birds as were not brought to bag into a long heavily wooded nullah, which always provides a most satisfactory holding covert. Nothing of much interest occurred, except that in one beat a large boar passed between me and the next gun, unfired at, since neither of us had time to slip in a ball cartridge; and we started beating down the long nullah before lunch. After that we moved to what is generally the best beat of all. I was centre gun, standing alone on an open sheet of rock. My shikari was out of sight on my right, covering the wet nullah along which we knew by experience that birds were inclined to run out. On his right again was G., another gun. Ten yards away on my left was my chokra Vasu, acting as stop behind a thick clump of bushes, and beyond him was H., the third gun, and his shikari.

The beat started, and we had all fired a few shots, when I heard an animal grunting some way in front. H.'s shikari called out that a pig was coming, and I thought it was probably the boar which we had seen earlier in the day. A head-on shot at pig is always unsatisfactory, so I moved some 10 yards to my right, where a tall but leafless thorn bush afforded a little cover from view. My intention was to take a side shot at the animal, as soon as it had passed me, and was clear of the others. It did not occur to me for one moment that it would do anything except break out by the most direct route, to escape from the clamour of the approaching beaters. Vasu was well covered from view by the thicket close to which he was crouching, and so long as I remained motionless, I was not likely to be spotted. Had I known that it was a panther and not a pig, I should not have considered any further precautions necessary.

As I reached my new stand, I opened my gun, and was on the point of slipping in a cartridge loaded with S.G., when through the top of the bush I saw a panther, obviously a female, coming out in big bounds, and seemingly on tiptoe. I remained motionless expecting her to pass at about 10 yards range, but evidently she spotted me, for on coming level she swung round at right angles, laid her ears flat, and came straight for me. Dropping the shot cartridge on the ground, I had time only to close the gun and fire one shot from the hip just as the panther reached me, and then went over backwards into the thorn bush. Whether she actually knocked me over, I cannot say; but one claw caught me on the right knee, and on the left leg of my shorts was a broad smear of blood which certainly was not mine; presumably it came from her wounded shoulder. However that may be, my shot fortunately deterred her from further attack, and she left me and rushed back into a thicket. I now became aware that Vasu was shouting loudly, so fearing that he too had been mauled, picked myself up, reloaded, and started to investigate. But I was relieved to meet him running up, and to find that his anxiety had been on my behalf, as he had witnessed the whole episode. He said that after leaving me, the panther kept falling over, so presumably one shoulder had been shattered by my shot. Feeling rather shaken, I then sat down to assess damage. It was amazingly slight. Besides the claw mark on my right knee which was bleeding freely, there was a painful wound in my left wrist, which we thought at first was due to a bite, but later proved to be a large thorn which had penetrated deeply, and then broken off; a fine crop of prickly pear spines in my backside did not make themselves known till later! While applying first aid, we heard the panther growl at a village dog which had gone to investigate, so as soon as I was ready we started to follow up. There was a good deal of blood across the sheet rock leading into some dense lantana bushes, but though we searched for 10 minutes or more we were unable to locate the animal, and in view of the necessity for early medical treatment, much to my regret I had to give it up for the time being.

But the idea of leaving a wounded animal to be a possible source of danger to the villagers, apart from questions of humanity, was unthinkable, and since my wounds were so slight and healed well, within ten days I was able to revisit the spot and renew the quest. Unfortunately, however, an intensive search of over two hours through some very thick stuff proved unsuccessful. There were no pug marks at the water within half a mile, and the shikaris were of opinion that the animal had got into one of the dense thickets we were unable to penetrate, and had died there. Actually they were wrong, for she had carried on for some distance further, and had died after crossing the river. Her remains were found the day after I had come away, and enough was left to show that my shot had, as I expected, smashed the right shoulder, but being a glancing one, had failed to penetrate. With such a wound it was surprising that she had survived for ten days. As to the reason for her attack, we could find no trace of cubs, whose presence would have accounted for such behaviour, but the shikaris were of opinion that she was the mother of a small cub which had been shot in the vicinity not long before in the course of a beat by another party. That may be so, but personally I think a more likely explanation is that hearing the beaters behind and the shots in front, she felt herself cornered.

I was extremely lucky to get off so lightly. My shot must have caught her in the split second when she was reaching out at me with her claws. Was it only a coincidence that not fifty yards away was the tamarind tree under which I had stalked a panther some time before, as related in the third section of this series? That too was a bad tempered beast which growled at us before moving on. The whole affair shows how easily accidents can happen, and that in the jungle one must always be prepared for the unexpected. Though the experience was not a happy one, the memory of my amazingly lucky escape is not likely to fade.

MY LAST TUSKER

When I wrote the chapter on elephants in this series, I little thought that I should ever be called upon to tackle another rogue. However, fate ruled otherwise, and since the following episode is typical of elephant shikar, and is at the same time a pleasant memory of the jungle, I am including it here.

Elephants are always to be found along the base of the northern slopes of the Nilgiris, but in 1950 they were unusually numerous, and solitary tuskers were constantly chasing people and generally giving trouble. My shikari's brother, whom I had known since he was a small boy, was killed close to Anaikatti village, and another man had previously met the same fate, so the two animals concerned were proscribed. No one else appeared to be keen on tackling them, so I decided that it was up to me to take the job on. After obtaining the necessary permit, I made three trips to Anaikatti during May and June in the hopes of shooting at least one of them, but without success. The smaller of the two seemed always to get wind of my arrival at the forest bungalow, for though he might prior to that have been in the vicinity for a week or more, no sooner had I appeared on the scene than he cleared right out of the area. The other and larger one proved equally elusive, and though we got on to his overnight tracks more than once, I was unable to come up with him. Then for a fortnight all trace of him was lost. I suspected—as indeed proved to be the case—that he had been wounded by someone and had retired to a place of refuge until he recovered. This elephant carried a very fine pair of tusks which met at the points, and gave him the name of 'Cross Tusker'.

On the 24th June I went down to Anaikatti again for the fourth time, which I determined must be my final effort. We could find no traces of either animal in the usual localities, so decided to try the circular valley below the Ebanaad waterfall, some 7 miles from the bungalow. This is a favourite haunt of elephants, and here if anywhere we might at last locate the rogues. Passing the Anaikalmarigudi temple, we entered the valley and proceeded along the track on the left side of the river, while the trackers worked the opposite slope. The path we were following was evidently well used by elephants, and during a halt a small tusker came round the corner behind us about 100 yards away. Fortunately we spotted him in time to take evasive action in case his intentions were aggressive, but he was not out for trouble, and on seeing us turned down to the river. Resuming our progress, we carried on till about 10.30 a.m. when we reached a central position where the trackers had asked me to wait until they could report results. We had not been there long when I heard a branch break in the river bed below us, and this was followed by a series of squeaks and squeals, some of which sounded remarkably like a dog barking. I thought it was a herd with baby elephants, but Kunmada, who went along the high bank till he got a clear view, reported that it was another small tusker, and not one of the proscribed animals. On getting our wind it turned back and went up a side valley to the left, and we saw no more of it. At 1 p.m. just as I was finishing my sandwiches, Bomma and the tracker arrived and reported that they had located Cross Tusker far uphill in a ravine which they pointed out, on the opposite slope. After so many previous fiascos I was rather sceptical, but both men were positive about the animal's identity, so obviously there was no alternative but to go and see for myself, little as I relished the thought of the tremendous climb which lay ahead, and its effect on an already weak heart.

The wind was blowing strongly up the valley, so it was necessary for us to continue on the same side of the river till we had got beyond the animal before crossing over. The path led through some unpleasantly thick brakes of bamboo and lantana, which I was relieved to pass without meeting any stray tusker, and rising steadily, at last brought us after an hour's hard going, to the head of the valley, where we crossed the river. Now came the worst part: an open spur of dry grass and loose stones, so steep that it was difficult to negotiate without slipping back. I never thought I should be able to manage it. However, after half an hour's slow but steady progress, we arrived near the spot where the elephant had been located. I sat down for a breather, while the trackers went on to ascertain whether the animal was still there. From my position I could see over the whole valley, and could appreciate the height to which we had climbed; in fact a reference to the map afterwards showed that we had ascended 2000 feet above the temple which we had passed in the morning.

The trackers soon returned and reported that all was well, so I climbed still higher and at last saw below me the huge brown form of the tusker. He was about 50 yards away in a regular *cul-de-sac* of immense rocks well shaded by bamboos on which he was feeding, and while we watched, he raised his tusks vertically, for the fact that they were touching at the tips prevented him from lifting his trunk to feed in the normal manner. There was now no possible doubt about his identity, but before firing it was necessary to approach closer, as an elephant's brain is small, and one wants to make sure of the shot. Cautiously descending, I reached a rock within 10 yards of the animal, which now had stopped feeding and seemed uneasy. Possibly a back eddy of wind from the cliff behind us had carried to him a faint taint of human scent. Obviously there was no time to lose, and though a head shot at an elephant standing tail on is far from satisfactory, there was no alternative, so I whispered to G. to get ready. I fired the right barrel of the .476 Westly Richards at the back of his head, and G. fired a second later with his .423. But the angle was too flat, as we were practically level with his back, and neither shot had any effect except to cause a slight stagger. Fortunately he then turned a little giving me a better angle. I fired again and this time there was no mistake, for the bullet entered behind the ear and passed through the brain. At the shot his hind legs gave way, and he fell backwards head over heels downhill, with a resounding crash, passing us almost within touching distance. It was an impressive sight. A final sharp crack warned me that a tusk had broken. After making sure that he was dead, though there could be little doubt about that, we descended to examine our prize and take measurements.

In spite of his obvious age, he was not a very large animal; only 9 feet 4 inch at the shoulder, and not to be compared with the 'Cradle Tusker' shot in 1932 which taped 10 feet 6 inch. But the tusks were a very fine pair, and after extraction measured 6 feet 6 inches and 6 feet 3 inches respectively. The right one had come in contact with rock as he fell, and a piece about 6 inches long had broken off the tip, but luckily we found it. I was amazed at the power of the .476 as compared with the .423, which I always have, and still do consider quite adequate for elephant. Whereas the bullet of the latter had remained in the skull, both those of the heavier rifle had passed clean through, the first emerging just above the bump, and the second between eye and earhole on the left. All three were of course solids.

And so Cross Tusker met his fate, and I obtained a very fine trophy. But as I sat alongside him enjoying the first cheroot of the day, I could not help regretting that it had been necessary to destroy such a magnificent animal, which may have been roaming those jungles for over a century. However, his life was forfeit, as he had killed at least one man already, and the four unhealed bullet wounds which he bore would have made him still more dangerous had he remained at large; so it was just as well that he should have no further chances of mischief. But what is one to think of the culprit who had fired those four shots, and then instead of following up and finishing off the animal, as every dictate of sportsmanship and humanity required, had failed even to report the matter to the forest authorities? However, a glance at my watch brought these reflections to an end. It was too late to cut out the tusks that day, but quite time that we were starting back. It was a long trek to the bungalow, and we did not get in till nearly dark, very tired, but with that comfortable feeling which success in shikar always brings. The pursuit of this rogue was typical of elephant hunting: days of searching, hours of tracking, and then the climax in a matter of seconds.

(*To be continued*)

THE BIRDS OF COORG

BY

F. N. BETTS

PART II

(With two plates)

(Continued from p. 63 of this volume)

Motacilla alba: The White Wagtail.

A fairly common winter migrant in the Dry Zone. Odd birds find their way up into the Inter-Zone. These usually settle down in some farm-yard or coffee pulphouse and spend the whole winter there, rarely moving a hundred yards from their headquarters.

Motacilla maderaspatensis: The Large Pied Wagtail.

An exclusively waterside wagtail whose range coincides with that of the Wire-tailed Swallow. They are found on all the large rivers of the Province, both those running out into Malabar from the foot of the Ghats, and the waters of the Cauvery system flowing east through the deciduous forest, becoming most numerous of all on the main river when it reaches the open country of the Dry Zone. The smaller streams and brooks among the higher hills do not attract them. They are found occasionally round large tanks but prefer running water. They are nearly always seen in pairs which hold together throughout the year, and spend their time hunting over the rocks and islets in mid-stream. If the banks are open they extend their forays some way inland particularly in the monsoon when the rivers are flooding. The breeding season is extended, beginning as soon as the rivers drop to dry-season level about Christmas, and continuing until the break of the rains in June. Nesting sites are varied. If possible they choose some grassy rock or islet well out from shore; in such situations the nest is tucked away among the roots of the long grass and very well concealed. Other sites which I have seen were in hollows of stranded tree-trunks, under bridges, and once on a car-ferry in constant use. They are always however within a few feet of the water. The nest is a rough collection of roots and coarse grass in the centre of which is a neat cup lined with hair. The birds have a loud, cheerful, rattling song which is as much a demonstration of anger or alarm as of pleasure, for it is uttered by both sexes when any intruder approaches the nest.

Motacilla cinerea: The Grey Wagtail.

The commonest of our winter migrants. They visit the whole of Coorg in great numbers though they are scarcer in the Dry Zone, and are one of the first species to arrive, coming in at the beginning of September, while odd birds linger on until mid-May. They scatter widely during the daytime, but in the evening gather in big communal roosts in thick trees or patches of lantana scrub. In some cases at least the identical birds return every year to the same winter quarters. One, distinguished by a particularly large white wing patch, spent three winters running in my garden, and used to conduct daily battles with its reflection in one of the bedroom windows.

Motacilla flava : The Grey-headed Wagtail.

A regular winter visitor to the Mysore 'Maidan' and almost certainly must visit the Coorg Dry Zone occasionally, though I have not seen it.

Dendronanthus indicus : The Forest Wagtail.

A common winter visitor in the Inter-Zone. Coffee plantations are their favourite habitat, but they may be found anywhere in evergreen woodland of an open type. They avoid dense forest, nor are they found in the deciduous forest belt or the Dry Zone. They are usually seen singly, feeding on the ground under the coffee or undergrowth, and fly up into a tree when disturbed, where they utter a 'chink, chink' note like that of the European Chaffinch, and oscillate the tail from side to side, not up and down like the true wagtails. They are much more arboreal than the latter, and a good deal of their food is found in the trees.

Anthus hodgsoni : The Tree Pipit.

A common and regular winter visitor, closely resembling the last species in habits and distribution. The Inter-Zone, particularly coffee land are their favourite haunts and they will rarely be found outside evergreen woodland. They live in flocks of considerable size, feeding on the ground and flying up into the trees when disturbed.

Anthus nilghiriensis : The Nilgiri Pipit.

Anthus similis: The Rufous Rock Pipit.

Both these species, particularly the second, might be expected to occur on the grassy crags of the higher Ghat peaks, but I have failed to find them myself and no one else has recorded them from Coorg.

Anthus rufulus : The Indian Pipit.

The common resident pipit of Coorg, found all over the Province from the Dry Zone to the high Ghat peaks, and even in the forest wherever there are considerable clearings. They are usually seen in pairs, and are typical pipits in all their ways. Such song as they have consists of a wheezy trill uttered as the bird flutters a few feet into the air and dives earthwards with closed wings. The breeding season extends throughout most of the dry season from January till the break of the rains. The nest is very well concealed in the depths of a grass tuft, and is only to be found by watching the bird. Three eggs form the usual clutch.

Anthus thermophilus. Blyth's Pipit.

A specimen from Coorg is in the British Museum. I have not come across this bird myself.

Mirafra affinis: The Madras Bush-Lark.

Fairly numerous in the Dry Zone in scrubby grazing land rather than cultivation, turning up again in large clearings and abandoned paddy fields in the deciduous forest provided the grass is short. Its requirements seem to be grassland with plenty of scrub and low trees. They may be seen singly or in pairs, feeding on the ground, creeping about very quietly and inconspicuously. The flight is weak and when disturbed they fly up into the trees. The breeding season is rather late, depending on the time of the first rains. The song is a succession of whirring notes uttered as the bird flutters up to a height of 30 or 40 feet and then floats down on outstretched wings to the nearest low tree or rock.

The only nest I have seen was found late in May and contained well-grown young. It was a grass cup, well concealed in a tuft of grass the growing blades of which were interwoven overhead to form a regular dome.

Galerida malabarica: The Malabar Crested Lark.

The common lark of Coorg and very numerous on open maidans and close-cropped grazing grounds throughout the Inter-Zone, and in cultivation and open country through the Dry Zone. They like short-grassed downland clear of scrub and trees up to an elevation of 4,000 ft. but are not found on the high downs of the Ghat summits. Except during the breeding season they tend to flock and wander a good deal, particularly during the monsoon. Nesting takes place from January till the break of the rains. Unlike many of the open country birds they do not wait for the first showers and many nests are destroyed in the grass-fires in March. The song is quite a fine one, uttered on the wing, the bird rising to a considerable height. Unlike the last species they are entirely terrestrial, rarely if ever perching on trees or bushes. The nest is built in the open without concealment, though often backing against a tuft of stiff grass. It is a neat cup nearly always surrounded by a conspicuous platform of dry grass and bits of cowdung. The young are clothed in down when hatched, and are fed very largely on grasshoppers. At an early stage they leave the nest and seek shelter in neighbouring grass tufts, where their cryptic plumage makes them very hard to find. The usual clutch is two.

Ammomanes phoenicura: The Rufous-tailed Finch-Lark.

Seen on one occasion in the driest part of the Dry Zone. It was very tame, relying on squatting motionless for concealment, and I was able to approach within two yards before it took wing.

Eremopteryx grisea: The Ashy-crowned Finch-Lark.

Only seen in one locality in the driest part of the Dry Zone. On a grassy patch of maidan just outside the village of Hebbale, one could usually come on one or two along the dusty cart tracks, dust bathing or picking about among the goat and cattle droppings. When flushed they merely flutter a few yards and settle again, or if one does not come too close, merely crouch without taking wing at all, thus hiding the conspicuous black underparts. I have not found a nest, but they probably breed there as they are very sedentary birds.

Zosterops palpebrosa: The White-eye.

Widely distributed through the wetter and more well-wooded portions of the Province. They are numerous in coffee cultivation and in the evergreen sholas up to the highest peaks of the Ghats, also in the canopy of the rain forest on their western slopes. They go about in large flocks keeping up among the tree-tops. Most nests in Coorg are built high up, well out of reach, in contrast to the Nilgiris where they are frequently found within a few feet of the ground. I have, however, found one in a coffee bush at four feet only. The nest is a tiny and very fragile, loosely-built hammock of fine grass, slung in a horizontal fork in a tuft of leaves at the end of a bough, and well-concealed. Two pale blue eggs are laid. The nesting season lasts through the hot weather from March to May, and breeding is sometimes resumed in September after the monsoon.

Cynnyris lotenia: Loten's Sunbird.

This sunbird is fairly common throughout the greater part of Coorg at medium elevations, but less so than either *C. asiatica* or *C. zeylanica*. They are most numerous in the Inter-Zone and the neighbouring parts of the deciduous forest, and on the lower Ghat slopes, but I have not seen them in the Dry Zone. As with most of the family, well-wooded but fairly open country with plenty of flowering trees and shrubs, gardens and cultivated land are their favourite haunts. In thick evergreen forest, where they occur at all, they are confined to the canopy. The nest may be distinguished from that of other species by the comparative lack of cobweb in the construction of the exterior. The outside is extremely untidy, being covered in a mass of dead leaves which hang below the nest proper in a ragged tail several inches long. They are usually at a fair height, ten feet or more, and tend to be built in the shade or in the interior of some fairly dense-foliaged tree, and would be difficult to find were it not for the bold demeanour of the birds. The main breeding season is March to May, and the normal clutch is two. The cock has a loud, sweet, cheerful song. The nectar of flowers and the small insects found in their corollas form the greater part of their food.

Cynniris asiatica: The Purple Sunbird.

This species is commoner and more widely-spread than the last and may be found anywhere throughout the Province, except perhaps in the heart of heavy evergreen forest. They are most cheerful, friendly little birds. Any flower garden is certain to have a regular population, and they play an important part in the cross-fertilisation of flowers. Their foreheads may often be seen plastered with pollen. Nevertheless, although the beak and tongue are so well-adapted for probing the recesses of blossoms, in many cases of flowers with long corollas such as *Hibiscus* and *Ipomoea* they do not approach by the front door, but find a short cut to the nectaries by piercing the petals at the base.

Nests may be found at almost any season but mostly between February and May. They are built in the most conspicuous places; a rose bush in a garden; suspended from a bit of string hanging in a verandah; a wire trellis or the extreme tip of some bare twig at any height between one foot and twenty from the ground, but usually within six feet of it. Despite the lack of concealment, the nest often escapes notice as it may easily be taken for a casual, wind-blown collection of cobwebs and rubbish. It is very like that of the last species, but a much greater use is made of cobweb which forms the major part of the exterior of the pear-shaped pouch. Dead leaves, pieces of bark and lichen are added freely and hang below in a ragged tail. The entrance is at one side with a well-defined porch above it. The outside casing is first completed and it is then well stuffed with vegetable floss by way of lining. As with the last species the hen does all the building, the cock merely accompanying her and singing loudly as she works. He does not appear to take any share in the incubation, but is active in feeding the chicks as soon as they are hatched. Very small insects seem to be the chief food provided for them. Two eggs is the usual clutch.

The male has a very distinct eclipse plumage in which the underparts are yellow with a purple ventral stripe, but the assumption of this seems to depend rather on the individual than the season, as one may see males in this condition while others are breeding.

Cynniris zeylonica: The Purple-rumped Sunbird.

Almost everything written about the last species applies to this one, except that the males have no 'eclipse' plumage. It is just as common and wide-spread, and unless the birds are seen it is almost impossible to distinguish the nests and eggs. A slight difference lies in the fact that the nests of the present species tend to be placed higher up, sometimes forty or fifty feet high in the top of a tree, and that they breed very freely in September after the monsoon which is not characteristic of *asiatica*.

Cynniris minima: The Small Sunbird.

The tiny sunbird is common in the Wet Zone and the moister parts of the Inter-Zone. It is more of a forest and jungle bird than the others and ranges higher, up to the tops of the Ghats. The nests are neater in appearance as they are made largely of green moss with little cobweb and usually lack the tail of rubbish hanging below. They are also quite frequently well-concealed in a terminal tuft of leaves. They are suspended from the tip of a twig, generally fairly low down in a bush or sapling on the edge of a woodland path or clearing. I have only found two nests, one in December and one in April.

Arachnothera longirostra: The Little Spider Hunter.

I have never come across this bird though I have kept a sharp look-out for it. Nevertheless it must almost certainly occur as Sálim Ali obtained it at Sakleshpur just over the border in typical Coorg Inter-Zone country.

Dicaeum concolor: The Nilgiri Flowerpecker.

Likely to occur, but not recorded as in the field it is impossible to distinguish from the next species. On the other hand as Sálim Ali only found it in the Billigirirangan Hills, it may be another of the high-level Nilgiri forms which reach their limit in that range.

Dicaeum erythrorhynchos: Tickell's Flowerpecker.

Extremely common all over the Province in cultivation or forest wherever there are trees afflicted with the parasites, *Loranthus* and *Viscum* spp. They feed voraciously on the berries, which pass through the body with great rapidity. The sticky mucous covering the seeds is quite undigested and on being voided they cling to any twig on which they fall. The flowerpeckers are undoubtedly the principal agents in the spread of these plants. They are very strong on the wing for such tiny birds, and fly high and rapidly and for long distances. They are birds of the canopy of the forest and seldom come below the tree-tops, while their nests are nearly always at a great height and exceedingly hard to find and even harder to reach when found. They are minute purses of green moss and spider cocoons lined with vegetable down, slung from the tip of a twig well-hidden in a bunch of leaves at the end of a lofty bough. Breeding takes place in Feb./March and again in September.

Piprosoma agile: The Thick-billed Flowerpecker.

Fairly common throughout the Inter-Zone and the adjacent deciduous forest, but I have not seen it on the higher Ghats or in the Dry Zone, and it is nowhere as numerous as the last species. They seem rather less dependent on the *Loranthus* than other flowerpeckers. They may often be seen carefully searching the extreme tips of the twigs of a leafless tree presumably picking up small insects on the buds. While doing this they have a characteristic habit of twisting the tail slowly from side to side. The nests, which are built in January and February while the trees are bare are quite unique. They resemble those of the last species in shape but instead of being hidden in a bunch of leaves they are fully exposed at the tip of a naked twig. Despite this they are far from easy to see, being so small and nearly always so high up. They are made of a peculiar reddish brown material apparently some sort of vegetable down woven into a solid felt, so compact that the nest may be crushed in the hand and will resume its shape when released.

Pitta brachyura: The Indian Pitta.

A regular and fairly numerous winter migrant. They turn up almost anywhere on their first arrival in October, and often very weary; understandably so considering the weakness of their wing power. During their stay in Coorg they frequent shady woodlands where they feed on the ground in the undergrowth, astonishing one with the flash of their brilliant colouring when they are disturbed and flutter weakly for a few yards. They are very silent and I have never heard them utter a sound. They have peculiar habit of bobbing on their long legs and at the same time jerking their almost non-existent tails like some mechanical toy. Some birds remain very late, up till the end of May, but I have seen no sign of their ever attempting to breed in Coorg.

Picus xanthopygaeus : The Little Scaly-bellied Green Woodpecker.

A scarce resident. A few pairs may be found scattered here and there through the Inter-Zone and the Ghat sholas. It does not, I think, occur in the drier parts of the Province. As with the other woodpeckers, it is an early breeder excavating a hole high up in some dead tree in January or February.

Picus chlorolophus : The Yellow-naped Woodpecker.

A common species in the Inter-Zone and the neighbouring deciduous forest, wherever there is a certain admixture of evergreen. They are usually seen singly or in pairs, frequently in the company of the mixed flocks, but the families do not seem to keep together after fledging, as do so many other woodpeckers. Breeding takes place early in December/January. The site chosen is some rotten tree trunk in deep shade in a wooded ravine, and the hole is usually within 15 feet of the ground. On a number of occasions I have found it placed immediately under one of the large plate-shaped fungus growths which are so common on dead trees in damp positions. Two or three eggs form the clutch. These woodpeckers are quiet birds but occasionally utter a very distinctive note, a single loud, sharp 'chak'.

Dryobates mahrattensis : The Yellow-fronted Pied Woodpecker.

Occurs sparingly in the driest parts of the Dry Zone where cultivation is mingled with scrub jungle and scattered large trees such as tamarind, peepal, and banyan. They are usually seen in pairs and are quiet and inconspicuous.

Dryobates hardwickii : The Pigmy Woodpecker.

Commoner than is generally realised in the Inter-Zone and the deciduous forest belt. It is a very quiet, unobtrusive little bird living among the upper branches of high trees, and is easily overlooked. It prefers fairly open woodland. Breeding takes place from December to February. The nests are usually very high up and quite inaccessible. The hole is bored in some quite small dead bough and the entrance is frequently on the underside. This is one of the species which I have noticed drumming. It is also the only one which I have seen carrying insects to the young in the beak. All the larger woodpeckers appear to feed the nestlings exclusively by regurgitation.

Micropternus brachyurus : The Rufous Woodpecker.

This remarkable woodpecker is fairly common throughout the Inter-Zone and the deciduous forest wherever giant bamboo grows and the *Cremastogaster* ants, with which it is symbiotic, are found. They are quiet birds, usually seen singly, and seem to feed almost exclusively on the above-mentioned ants which build large black 'papier mâché' nests in treetops and tall bamboos. They breed in February and March in these same ants' nests. A hole two inches in diameter is bored in one side, and the interior excavated leaving a wall an inch thick. What is so extraordinary is that this does not cause the desertion of the original owners who remain in occupation of the walls throughout the whole period of incubation and fledging. I have climbed to an occupied nest and been furiously attacked and yet found naked young inside completely unharmed. Shot specimens are said to have a peculiar acrid smell due to their diet of ants, and one can only assume that this extends to the young and protects them from their vicious little hosts. Certainly few birds can have such well-protected nest!

Brachypternus benghalensis: The Golden-backed Woodpecker.

Common throughout the Inter-Zone, the deciduous forest, and the more well-wooded parts of the Dry Zone. Generally the commonest woodpecker of the countryside, a noisy, conspicuous bird usually seen in small family parties, and an invariable member of the mixed flocks. Breeding takes place between December and February. The nest is excavated in the trunk or a main bough of a dead tree in open woodland or coffee plantations. It may be at any height from the ground, but is commonly between ten and twenty feet. The entrance is a neat round hole with the horizontal axis usually slightly greater than the vertical.

Dinopium javanense: The Three-toed Golden-backed Woodpecker.

Similar in every way to the last species. Their range very largely overlaps, but the present bird tends to favour a wetter biotope and is absent from the Dry Zone. It is nowhere nearly so numerous as *B. benghalensis,* and is much quieter. The nesting habits appear to be very similar. The two species are by no means easy to distinguish in the field, the best mark being the rump and lower back when seen in flight: crimson in this bird, black in *B. benghalensis.*

Chrysocolaptes guttacristatus: Malherbe's Golden-backed Woodpecker.

Very similar in habits and distribution to *B. benghalensis* and *D. javanense* but it prefers a wetter climate and higher altitude. They range through the evergreen forests of the Wet Zone up to the highest Ghat sholas, and abound in the coffee plantations of the Inter-Zone, but scarcely enter the deciduous forest. They are bold noisy birds usually seen in family parties. The call is a high, tinny scream, very distinctive. Breeding begins very early as I have found occupied nests in December, though apparently only one brood is raised. The same dead tree may be used for years in succession, a new hole being excavated each time. The nest of this bird can be distinguished at a glance as the entrance is oval with the long axis vertical, while the lower edge is bevelled off at a slope in a rather untidy manner. The normal clutch is two or three.

Chrysocolaptes festivus: The Black-backed Woodpecker.

May possibly occur very rarely in the Dry Zone. I have once seen it in a coconut plantation at Periapatam a few miles over the Mysore border.

Hemicircus canente : The Heart-spotted Woodpecker.

Common in the Inter-Zone and the deciduous forest, but not found in the Wet or Dry Zones. In fact their range coincides with that of the giant bamboo. They are odd little birds with ridiculously short tails and quaint jerky movements. Presumably owing to the shortness of the tail they do not assume the usual woodpecker attitude, braced against a tree-trunk or branch, but perch across a bough like a Passerine and search the small twigs rather than the main limbs for food. They are usually seen in pairs which keep in touch by a constant squeaky call, flying from tree to tree with a comic exaggeration of the typical bounding woodpecker flight. I have never been able to find a nest though they are strictly resident, but suspect them of excavating holes in the bamboos.

Dendrocopos javanensis : The Great Black Woodpecker.

Occurs throughout the Wet and Inter-Zones and occasionally in the deciduous forest, but is never numerous. It is essentially a bird of the deep forest, only found where there are extensive tracts of woodland with trees of the largest size. They are great wanderers, however, and are often seen in coffee plantations on the borders of forest. They live in small family parties for most of the year and are extremely noisy, the loud clanging calls being audible at a great distance. In spite of this they are extremely shy, especially at the nest. This is excavated early in January high up in some tall dead tree. The size of the circular entrance hole, a good five inches in diameter, serves to distinguish the ownership at once. The interior hollow is about two feet deep by a foot wide at the bottom. Though normally so noisy the birds are most careful to avoid being seen or heard in the neighbourhood of the nest, and will desert at once if they think they have been detected, even if no attempt is made to climb the tree. During incubation the brooding bird pops her head out of the entrance at the slightest unfamiliar sound, but flies off only if danger actually approaches. Most woodpeckers and barbets have this habit which has a definite protective value. The dark, clean-cut entrance shows up conspicuously at a distance, and the projecting head blocks this and looks like a natural branch stub.

The only nest I have been able to reach had four incubated eggs.

Vivia innominatus : The Nilgiri Speckled Piculet.

Probably more numerous than one suspects for as Sálim Ali points out it may very easily be overlooked. I have only seen one once in ten years' residence, when I found a nest in March in a dead branch of a large tree in a shady ravine forming an isolated strip of evergreen just inside the deciduous forest. The bird flew out with an almost inaudible squeak and remained hopping anxiously about among the top branches of a neighbouring tree, perching across and not along the twigs. The entrance to the nest was barely an inch in diameter, smaller even than that of *D. hardwickii,* while the chamber was about six inches in depth and two and a half in width. There were two glossy white, almost spherical eggs. There was an occupied nest hole of *Megalaima viridis* a foot higher up in the same stub.

Megalaima viridis : The Small Green Barbet.

One of the commonest birds of Coorg especially in the Inter-Zone. Their monotonous notes resound ceaselessly all day in all directions, and it would be almost impossible to find a spot anywhere in the wooded parts of the district during the dry season whence at least half a dozen could not be heard calling. They are fairly common in the Ghat sholas though scarce in the interior of extensive evergreen forest. They are also found in small numbers in the Dry Zone where one would expect to find them replaced by *T. zeylanicus.* The latter species, however, does not seem to occur. Their real home is the coffee land where the shade trees provide ideal living conditions. The various fig trees furnish a supply of food throughout the year, and those killed and left standing during shade control work provide the dead soft-wooded stumps which they especially prefer for nesting purposes. They are almost entirely frugivorous, but I have seen them catching large insects on the tree trunks, and they sometimes join in the feast when there is a flight of termites, though their efforts at fly-catching are clumsy and not very successful. The principal breeding season is from February to April, but they start excavating holes as early as September. These do not appear to be used unless for roosting as I have never found eggs before New Year. Work goes on in a desultory manner. There are two or three days of feverish digging and then the job is left for a week or so, or may even be deserted. Two eggs are laid. The young are fed on fruit from the earliest stages. At first this is regurgitated, but later given direct. A fresh chamber is normally dug out for each brood, but I have once or twice found them breeding in what appeared to be an old hole. The nests may be excavated in any dead soft-wooded tree at any height from the ground, sometimes even in a fence post. In Coorg quite the favourite species is *Ficus glomerata*, one of the commonest coffee shade trees. This, when two years dead, has a smooth barkless outer surface with a hard rind half an inch thick while the interior is soft punk which can be dug out with the fingers.

Barbets are quarrelsome birds and though several pairs may breed in the same tree, and scores be seen feeding together on a big fig in fruit, there is continual bickering and querulous argument which often ends in actual fighting.

Megalaima haemacephala : The Crimson-breasted Barbet.

Confined to the Dry Zone being replaced in the Inter and Wet Zones by next species. Its range extends up to the deciduous forest where the two overlap but rarely intermingle, the present bird being found in the drier and more open parts, while *X. rubricapilla* prefers areas where there is an admixture of evergreen. It is nowhere numerous in Coorg, suitable fruit trees and nesting sites being scarce in its range.

Megalaima rubricapilla : The Crimson-throated Barbet.

This species has practically the same range as *Megalaima viridis* and is as common. Its metallic 'tonk, tonk, tonk' uttered for minutes together without a break is one of the most familiar bird calls in

Coorg. In feeding and breeding habits they resemble their larger cousin. By preference, however, they choose small boughs in which to excavate their nest holes, sometimes so slender that the walls of the chamber are not more than a quarter of an inch thick. They show great skill in their carpentry and rarely break through the sides and spoil the work. A horizontal bough is often chosen and the entrance is on the under side. February to March are the principal breeding months and two eggs are laid.

This species is even more exclusively frugivorous than *M. viridis* and I have never seen insect food being taken.

Cuculus poliocephalus: The Small Cuckoo.

Has been recorded from Coorg. I have not seen it myself.

Hierococcyx sparveroides: The Large Hawk-Cuckoo.

I suspect that this bird occurs as I have on several occasions seen a very large Hawk-Cuckoo, but I have not definitely identified it.

Hierococcyx varius: The Common Hawk-Cuckoo.

A common winter migrant throughout the Province. I have only seen them between October and April, and while with us they are silent and furtive. I have never heard the call, so it seems unlikely that they breed here.

Cacomantis merulinus: The Plaintive Cuckoo.

Not uncommon in the Inter-Zone, but I have been unable to determine its status. It appears to be a wandering bird, stray specimens turning up at any time of year and disappearing after a few days' stay. I have heard them calling but have no evidence of their breeding. They are quiet, skulking birds living in scrub and lightly wooded country. I have seen one feeding on a repulsive looking scarlet bug which lives on rotten fruit and which from its gaudy, warning colouring one would have expected to be highly distasteful.

Penthoceryx sonneratii: The Banded Bay Cuckoo.

It is surprising that the Mysore Survey did not come across this bird as it is the commonest of the small cuckoos in Coorg and the only one of which I have definite evidence of breeding. It is fairly numerous in the Inter-Zone and lower Ghat sholas. I have not seen it in the Dry Zone. I suspect that these birds migrate during the monsoon as one does not encounter them between July and December. In March and April they become very noisy, and their loud 'crescendo' call is continually uttered. They inhabit much the same country as *C. merulinus,* fairly light forest and well-wooded cultivation, but are more arboreal and keep to the treetops. The usual host for their young is the Iora, though I have once seen one being fed by a pair of Magpie Robins. Early in the monsoon when the big mixed flocks first form, one may often see a young of this cuckoo in the party being attended by its foster parents. It keeps up a continuous loud, querulous call, and though strong on the wing and apparently perfectly capable of looking after itself, makes no attempt to find its own food.

Surniculus lugubris: The Drongo Cuckoo.

I believe I once saw one in the Dry Zone but could not be quite sure, and the record must be taken as doubtful.

Clamator jacobinus: The Pied Crested Cuckoo.

Occurs apparently as a scarce and irregular winter migrant. I have seen them in the Dry Zone, but more frequently well up on the Ghat hillsides on the borders of sholas. They are evidently on passage as they are here today and gone tomorrow. I have never heard them calling and do not think that it is at all likely that they breed in Coorg.

Clamator coromandus: The Red-winged Crested Cuckoo.

Once seen in the heart of a dense evergreen hill shola at about 4,500 ft. in May. It was skulking silently in the undergrowth and was very tame, allowing close approach and observation, so I have no doubt of the record. Evidently a mere rare straggler to Coorg.

Eudynamis scolopaceus: The Indian Koel.

Resident in small numbers in the Dry Zone. It is a regular visitor to the Inter-Zone in the hot weather apparently to breed though I have never seen young birds there. From January to March they are found in cultivation and lightly-wooded grazing grounds near villages, wherever in fact their hosts, the crows, abound. They betray their presence by their reiterated crescendo call, but are otherwise somewhat shy, keeping to the interior of leafy tree-tops. When moving from one to another, they dash across the open space with a great flurry and bustle as if in a desperate hurry, probably to escape the attentions of the crows, who lose no opportunity of harrying them. They leave the district on the outbreak of the monsoon. Males seem greatly in the preponderance, but this may be because they are more conspicuous.

Rhopodytes viridirostris: The Small Green Malkoha.

A resident in the Dry Zone in small numbers. They certainly breed there though I have not found the nest. In the cold weather from November to March they wander up into the Inter-Zone where they are found on scrubby downland and grazing grounds, but not up to any height on the Ghats. It is a silent, solitary, skulking bird seldom seen far from some lantana brake where it can hide if alarmed.

Centropus sinensis: The Common Crow-Pheasant.

A very common bird all over Coorg in almost every biotope, though scarcer in the more open parts of the Dry Zone. They ascend the hills to the highest sholas on the Ghats and are equally at home in the steamy tropical jungles at their western foot. As one would expect with a bird of such weak wing power, they are extremely sedentary, each pair remaining year after year in their own comparatively restricted territory. They breed in tangled cane brakes or trees in evergreen forest smothered in creepers and lianas, while in the drier areas a favourite site is in the heart of a clump of giant bamboos where the interlocking stems hold up a mass of dead leaves and debris and form an impenetrable stronghold. They are very adaptable birds however, and are one of the few species which have made themselves really at home in tea cultivation, where the open nature of the land, and the constant weeding and tidying that goes on, is by no means to the taste of most forms of bird life. Here they breed in the crowns of pollarded *Grevilleas* lining roads or planted as wind-breaks. The nests are simply made by twisting the living, growing leaves into a rough dome open at both ends, and despite the size of the bird they are remarkably inconspicuous. The usual breeding season is in June and July, during the rains, but after the first and heaviest burst.

Psittacula eupatria: The Alexandrine Parakeet.

I have seen this species in Coorg on two occasions only; once a solitary bird in the Dry Zone near Hebbale, and once a large flock flying home at sundown to roost in a patch of sugarcane near Yaslur in the extreme north of the province. This, though well in the Inter-Zone, is much more open country than most of Coorg—treeless downs with coffee and cardamom, and paddy cultivation along the streams in the valleys.

The large size of these parakeets and their very distinctive call make them unmistakable.

Psittacula krameri: The Rose-ringed Parakeet.

A common bird in the Mysore maidan, occasionally wandering over into the Coorg Dry Zone.

Psittacula cyanocephala: The Blossom-headed Parakeet.

The common parakeet of Coorg, extremely numerous throughout the Inter-Zone and the deciduous forest and also found in the Dry Zone. They avoid, however, the Wet Zone forests and are not seen above 4,500 ft. While mainly frugivorous, they appear to eat large quantities of leaves and buds and are extremely wasteful and destructive in their feeding habits. At certain times of year they are a plague in a garden. A flock will strip a hibiscus hedge bare of every leaf in a couple of mornings. They are highly sociable and live in large flocks. They breed early, pairing off in the first week of January. They nest usually in old barbet or woodpecker holes or natural hollows, enlarging them considerably to suit their requirements. One can always tell when a parakeet has been at work by the shape of the chips of wood at the foot of the tree. A woodpecker or barbet chisels out long slivers, while the parakeet bites out dice-shaped chunks. Two or three eggs are laid. The hen alone incubates and during the process her long tail feathers become very abraded and worn down to less than half their proper length. The young are fed by regurgitation and at long intervals, certainly not oftener than once an hour. In nests which I have kept under observation, the hen alone supplied food. By early April the young, distinguishable by their green heads and short tails, are all on the wing.

Out of the breeding season, these parakeets roost communally in large, dense-foliaged trees. They are very noisy birds, but their voices are not unmusical and are quite pleasing to the ear.

Psittacula columboides: The Blue-winged Parakeet.

Replaces the last species on the higher Ghats up to 5,000 ft. and in the wetter parts of the province. They do not extend to the Dry Zone, but over most of the Inter-Zone the two occur side by side in equal numbers. In habits this bird is entirely similar to *P. cyanocephala*, and is quite as noisy, but in this case the screams are extremely harsh and discordant.

Sálim Ali states that in Mysore this is the only Parakeet found in the coffee plantations, but in Coorg both this and *P. cyanocephala* occur and breed freely in coffee cultivation.

Coryllis vernalis: The Indian Loriquet.

Very common throughout most of the province in well-wooded areas. It is not found much above 4,000 ft., and I have not seen it in the Dry Zone. These little birds, though almost as numerous as the parakeets, are not nearly so conspicuous. Their small size, leaf-green colouration, and predilection for the highest treetops all help to conceal them, while unlike their larger relatives they are by no means noisy, their only note being a low, squeaky, bat-like trill. They do not flock, and except when the young have just flown are seen singly or in pairs. They feed largely on the nectar of flowering trees, clambering from truss to truss with the aid of beak and claws in a highly acrobatic manner, being quite as much at home hanging upside down as when the right way up. They breed in January or February in natural hollows of trees at any height from ten feet upwards. The holes are enlarged to suit, and a small pad of green leaves is added by way of lining. In this they differ from the parakeets, none of whom line their nests. The clutch is a large one, 5 or 6 eggs being laid. The young are fed by regurgitation and there appears to be only one brood annually.

Coracias benghalensis: The South Indian Roller.

Quite a common resident in the open, cultivated Mysore 'maidan' country round Periapatam and Hunsur beyond the eastern border of Coorg. I have found them breeding in holes in dead palm trees killed by excessive toddy tapping. In the province it is a regular but casual winter visitor, turning up in clearings in the deciduous forest, and on open grazing grounds in the Inter-Zone, but seldom lingering in one spot for more than a day or two. They are sluggish birds, spending hours together perched on a telegraph wire or treetop, flying down at intervals to catch a grasshopper or other insect on the ground. Their powers of sight must be phenomenal as I have frequently seen one spot some quite small prey at a distance of at least a hundred yards. Comparatively dull-coloured while at rest, the sudden flash of brilliant blues as it opens its wings is positively dazzling. In the breeding season they become more active, indulging in remarkable antics on the wing, rolling and swerving like a tumbler pigeon and uttering the most diabolical screams. An odd pair or two may breed in the Dry Zone among the cultivated lands along the Cauvery, but I have never found a nest myself.

Eurystomus orientalis : The Broad-billed Roller.

Not yet seen in Coorg, but it is extremely probable that it does occur in the clearings and rubber plantations in the tropical evergreen forest on the western slopes of the Ghats.

Merops orientalis : The Indian Bee-eater.

A very numerous winter visitor all over the province except in the most thickly forested areas. They appear in early October, and the great majority depart in March to breed. Odd solitary pairs, however, remain and nest in sandpits or roadside cuttings usually in grazing land or on the Ghat downs. During the winter months they are highly sociable, living in large flocks. They are intolerant of cold and on a chilly January morning, 40 or 50 little towzied green balls can often be seen packed tight as sardines along a bough, refusing to stir till long after sunrise when the world has begun to warm up. They are very fond of taking dust baths on sandy roads.

Breeding takes place between December and February. The nest tunnels vary considerably and may be excavated in vertical banks or in almost level ground. Unless the soil is very intractable, they are of considerable length, 4 feet or more, and wind and twist to avoid stones and roots. Wherever possible they are sloped slightly upwards. The bird pecks away at the soil and then throws back the loosened material with a furious scratching action using both legs so that the dust flies out in a cloud. A newly excavated hole can always be recognised by the two grooves made by the feet in the floor of the entrance. Both birds feed the young which number five or six. The latter do not leave the nest until they are fully fledged and already strong on the wing.

Merops superciliosus [javanicus] : The Blue-tailed Bee-eater.

Common along the seashore on the Malabar coast. I have only once met them in Coorg when a small colony of three or four pairs lived for some months around Halagote Kere, the only tank of any size in the province, in the Dry Zone. I did not actually find the nests, but they certainly bred there as I saw them feeding very newly-flown young on 25th May. They left at the beginning of the rains and never returned in subsequent years. In habits they closely resemble the last species.

Merops leschenaulti : The Chestnut-headed Bee-eater.

A well distributed resident species throughout the province. They are water-loving birds and spend most of the year in small flocks along the Cauvery and other large rivers, both in their upper reaches where they flow through the deciduous forest and in the Dry Zone where the banks are open and cultivated. During the monsoon the flocks leave the rivers and wander far and wide over the countryside. They breed colonially, half a dozen pairs scattered over a hundred yards of ground, excavating their holes in sandbanks on the river's edge, avoiding by preference anything like a vertical face. In fact they often choose almost level ground and such soft sand that it is remarkable that the holes do not cave in. The tunnels vary from two to six feet in length, but are usually nearer the latter figure. The season is March to May.

Five or six eggs are laid. Like so many insectivorous birds, they bathe and drink on the wing, flying down to the water and dipping and splashing for a second before rising again.

Alcemerops athertoni : The Blue-bearded Bee-eater.

An uncommon bird though widely distributed through the province in wooded country. They are most commonly seen on the edges of clearings and young teak plantations in the deciduous forest. They are sluggish birds compared with their smaller relations, and spend most of their time perched on an outstanding bough, only taking wing when some insect is actually in view, and rarely if ever soaring and cruising round in flight. The note is a harsh, low, most distinctive croak audible at a surprising distance and like no other bird note. The only attempt at breeding which I have come across was when a pair started excavating a tunnel in September in a roadside cutting in a coffee estate. It was abandoned after reaching a length of eighteen inches and the birds disappeared without making a second attempt. This rather unusual breeding season was confirmed some years later at the other end of India in the Lushai Hills of Assam. In a hundred-mile march from Aijal to Lungleh in early October, I passed literally dozens of tunnels in process of excavation in the banks of the mule track in bamboo jungle.

Ceryle rudis : The Pied Kingfisher.

Common on the larger rivers such as the Cauvery, Hemavathi, and Lakshmantirtha after they leave the forest and enter the Dry Zone where their banks become open and cultivated. They are exclusively fish-eaters and do all their hunting on the wing, flying up to a height of fifteen to twenty feet where they hang hovering motionless on rapidly beating wings, the tail spread and bent forward as a brake and the bill pointed vertically downwards while they scan the water for anything edible. If prey is seen the bird turns over and plunges vertically down on it. If not, after a few seconds it flies on to hover again in a different spot. They are early breeders, excavating a hole in January in some vertical clay bank on the riverside, three or four feet above water-level. It is not usually of great length, 12 to 18 inches being normal. The chamber is some nine inches in diameter and five or six eggs are laid. As with all kingfishers the nest becomes extremely foul before the young finally leave. Both chamber and tunnel are choked with a stinking litter of fish-bones, scales, and excreta, swarming with maggots. The young only emerge when fully developed, and remain dependent on their parents for a couple of weeks. It is a delightful sight to see half a dozen youngsters sitting on a rock in mid-stream being fed industriously by the old birds.

Alcedo atthis: The Indian Common Kingfisher.

Found throughout Coorg wherever there is water along the streamlets running down from the high hills, whether they run through open downs, thick forest, or paddy fields, and equally on the larger rivers both in the Wet and Dry Zones, and also on nearly every tank or cattle pond. They resemble their near relative the European Kingfisher in habits, feeding on small fish and tadpoles which are caught by diving from a perch overhanging the water, though they occasionally hover like the Pied Kingfisher. The usual breeding season is in March/April but I have found a nest in September so that there may be two broods. The tunnel, 3 or 4 feet long, is excavated in a vertical river bank, but I once found one in the wall of a dry well three feet below ground level and two hundred and fifty yards from the nearest water.

Alcedo meninting: Beavan's Kingfisher.

This species which closely resembles the last is distinguishable in the field by the lack of the white shoulder patches and the deeper blue of the upper parts. It is a rare bird. I have only once seen a pair on one of the main tributaries of the Cauvery where it flows through heavy bamboo forest. Though only a sight record the birds were tame and I was able to observe them carefully and am confident of the identification.

Ramphalcyon capensis: The Brown-headed Stork-billed Kingfisher.

Found wherever a suitable biotope occurs though never numerous, as each pair occupies a large territory. They are confined to the larger rivers where they flow through thick, wild forest, and will never be seen in open country. They are shy birds, spending much of their time perched in some thick tree overhanging the water. They are the possessors of portentous voices, bursting forth at intervals into a terrifying cacophony of wild, shrieking laughter, bobbing up and down on the perch, and flicking up the short tail till it almost touches the back. Breeding presumably takes place in the hot weather, but I have never succeeded in finding a nest or seen young, though the old birds are undoubtedly resident throughout the year.

Halcyon smyrnensis: The White-breasted Kingfisher.

The commonest kingfisher in Coorg, and unlike the others by no means confined to the waterside. They are most numerous in and about paddy fields, but one also finds them in cultivation or jungle clearings a long way from the nearest pond or stream. They ascend the hills to the limit of paddy cultivation, and elsewhere are numerous in fairly open country throughout the Wet, Inter, and Dry Zones. They feed very largely on big insects, small lizards, and land-crabs, employing the typical kingfisher tactics of swooping down from a perch. They are also quite at home in more normal surroundings along the rivers and as adept at fishing as the rest of the family. The call is a loud, piercing laugh. Breeding takes place in late March and April, the tunnels being excavated in vertical banks, sand-pits and roadside cuttings often far from water. The very first nest I found was in a hole left for drainage purposes in the masonry of a bridge, but they generally dig their own dwelling. The passage is often quite short, 18 inches or less. Four to six eggs are laid.

Halcyon pileata: The Black-capped Kingfisher.

This is a coastal species, common on the brackish estuaries, backwaters and mangrove swamps of the Malabar Coast. Nevertheless, I have met it twice in Coorg; once on a small stream running through a coffee plantation at 3,000 ft., and once on the Cauvery some five miles away. In the former case I saw a solitary bird on one occasion only, in January. Two years later, possibly the same bird turned up in the same spot and remained for several months, in fact until the break of the monsoon. In size and build they resemble *H. smyrnensis* closely, but apart from the black head, may be distinguished in the field by the deep, purplish blue upper parts which in *smyrnensis* are a lighter shade tending to green.

Dichoceros bicornis: The Indian Great Hornbill.

Must almost certainly occur in the heavy rain forest of the western slopes of the Ghats, but I have not come across it.

Hydrocissa coronata: Malabar Pied Hornbill.

Found in the Wet Zone rain forest on the Ghat slopes running down to Malabar. Seen in small parties, but not at all common.

Tockus birostris: Common Grey Hornbill.

Common in the Dry Zone wherever there are large trees such as roadside avenues of banyans, and also found throughout the deciduous forest belt. They are usually seen in small flocks of half a dozen individuals though I once saw one of at least fifty. They are noisy birds with a great variety of loud, weird calls. The only nest I have come across was in a hole in a big horizontal bough, 50 feet up in an enormous wild fig standing on the bund of a tank in the Dry Zone. This was in April, and one bird only was bringing food (fruit of some sort), so presumably this was the male feeding his sitting mate.

Tockus griseus: The Malabar Grey Hornbill.

Replaces the last species in the evergreen forest of the Wet Zone where they are fairly common from almost sea level up to 4,000 ft. They are strictly forest birds, more often heard than seen. Like the last species they live in small flocks and are equally noisy. I have not found a nest.

Upupa epops: The Hoopoe.

Permanently resident in the Dry Zone, and a common dry weather visitor to the more open parts of the rest of the province, arriving in September, remaining to breed in February/March, and only leaving in June at the onset of the monsoon. They are essentially ground feeders, running about actively on their short legs, picking up ants and small insects, and probing the cracks and crannies of the soil with their long, curved bills. In the Nilgiris they breed freely in holes in stone walls and buildings. In Coorg I have found them always to choose natural hollows in trees, especially clefts and splits in the trunks, the result of lightning blast or the breaking of a major limb. Where the entrance is a very narrow one, it often presents a pecked appearance the birds evidently enlarging it sufficiently to allow easy access, though considering their long, delicate bills, this work must be very difficult for them. Half a dozen greeny-white, rough-shelled eggs are laid. The hen apparently does all the incubation. The cock at this time roosts somewhere in the neighbourhood. In the case of a nest near my bungalow, he used to occupy a wide fork in the trunk of a small tree some three hundred yards away, in which he squatted instead of perching on a twig in the manner of most arboreal birds. The eggs are laid on a pad of moss and hair, and soon become very stained as there is no attempt at sanitation, and when the young hatch the hole becomes extremely foul.

The familiar double call from which the bird gets its trivial name is uttered with closed crest, swelling neck, and bill pointed vertically downward. It has the effect of coming from a distance even when the caller is close at hand. During courtship or when alarmed or angry it has another call, a harsh, croaking scream. In the courtship display the crest is erected and the wings spread and fluttered to show off the black and white barring. I have seen copulation taking place even when incubation was well advanced which seems unusual, the cock calling the hen off the eggs for the purpose. Both birds take part in feeding the young, and work most industriously. They seem to give themselves a lot of unnecessary labour. In the case of the above-mentioned nest near my bungalow, they used to fly to a maidan at least a quarter of a mile away before starting to search though there were precisely similar and apparently equally fruitful feeding grounds much nearer at hand.

Harpactes fasciatus: The Malabar Trogon.

Scarce but widely distributed. They seem to be great wanderers, singletons or pairs turning up for a few days at a time almost anywhere in the deciduous forests and coffee plantations in the Inter-Zone, or the Ghat sholas of the Wet Zone up to high levels. Although I cannot prove it, I suspect that the rain forests of the Malabar slope are their real home. They are sluggish birds, usually encountered in the interior of heavy forest, perching for long periods on a bough, and flying out occasionally to take an insect on the wing. The only note is a low croak seldom uttered. The long tail, square at the tip and the same width throughout its length, is a very distinctive feature. I have once found a nest. This was in March and it was in a big, natural hollow in a rotten branch stub, twenty feet up in a fig tree in a coffee plantation. The three eggs were laid on the decaying chips with no attempt at a lining.

Micropus melba: The Alpine Swift.

Colonies of these swifts live on most of the higher precipitous crags of the Ghats. While birds of such great wing power must cover enormous distances during the day, they appear to return to their home cliffs to roost, at any rate during the Dry Weather. In the monsoon the hilltops are wrapped in almost continuous fog and rain, and it is probable that they migrate as Sálim Ali records of the Jog birds, but I have no idea where they go as I have never seen them in Coorg except on the hills. They breed in January in clefts in the face of cliffs, usually in some quite inaccessible position. The nest is a flimsy half saucer of feathers and straw cemented with saliva. One colony of my acquaintance builds within 6 feet of a Shahin Falcon's eyrie, neither species taking the slightest notice of each other. In addition the neighbouring rocks are festooned with the combs of the big Rock

Bee, but the swifts fly in and out among them without the least compunction.

Micropus affinis: The Common Indian House-Swift.

Locally common. Colonies of varying size breed in large buildings in the chief towns, such as the Fort at Mercara, and the Kachcheri at Somwarpet. They also use the underside of big bridges and more rarely cliffs on the Ghats. Their breeding season seems to differ considerably according to locality. They nest in June and July under the arches of bridges over the Cauvery in the Dry Zone. This is during the rains which, however, are light in that area, and it is probably the season of maximum insect abundance. The large colony on Mercara Fort in the Wet Zone only starts operations in September after the worst of the cold, wet monsoon weather is passed. The nests are built of feathers, straw and any air-borne rubbish, cemented with saliva, and are more or less hemispherical with a small entrance hole. But usually forty or fifty are glued together in one amorphous lump, so that it is impossible to tell their real shape.

Chaetura giganteus: The Brown-throated Spinetail.

This grand swift is something of a mystery. They turn up regularly in the wake of the violent thunderstorms which mark the end of the Dry Season in April and May. Large numbers appear in open country, swooping low over the newly moistened ground, feeding on the swarms of awakening insect life. They fly at an immense speed, and as they sweep past their wings make a noise like a sword cut. At other times of year they are rarely seen, though they probably breed in the Ghat forests. Unlike most swifts they are silent birds.

Indicapus sylvaticus: The White-rumped Spinetail.

Quite a common species, but like the last puzzling in its distribution. They are seen in large flocks, most often along rivers but they may turn up anywhere. They seem to have no fixed abode and I have never found them breeding. They are, however, mainly forest haunters and I have rarely met them in the Dry Zone.

Collocalia fuciphaga: The Edible-nest Swiftlet.

Not Common, but colonies exist on some of the higher and craggier hills of the Ghats. The only actual breeding site with which I am acquainted is beyond the Coorg border on the Kudere Mukh, the highest peak of the Mysore section of the Ghats. Here twenty or thirty pairs nest in the belfry of a ruined Jesuit chapel at over 7,000 ft. The nests are small, shallow half-saucers, largely composed of whitish, isinglass-like saliva with a plentiful admixture of green moss. The males and non-breeding members of the colony roost beside the sitting birds, clinging back downwards to the rafters on which the nests are glued. The above colony and the only other I have seen—in Ceylon—were both breeding in March. Two eggs are laid.

Hemiprocne coronata: The Indian Crested Swift.

A common species in the deciduous forest and the neighbouring parts of the Dry and Inter-Zones. They are birds of fairly light, open woodland country. While strong on the wing they are not nearly such wanderers as the true swifts, and remain in more or less the same area throughout the year except perhaps in very stormy weather. They perch freely on trees. Breeding takes place from late February until April. Three or four pairs usually nest within a few hundred yards of each other. The nest is a minute half-saucer an inch and a half long by an inch wide, just large enough to contain the single egg. It is composed of a grey, horny substance two or three millimetres thick, apparently a mixture of dried saliva and shreds of lichen. This is glued to the side of a thin, bare bough in a treetop. It may be sixty feet up in a giant *Bombax*, but often a low scrubby tree not twenty feet high is chosen. The incubating bird perches on the bough in the normal manner, and covers the egg with her breast feathers. The only way of finding a nest is to watch until a bird is noticed continually returning to a particular perch, as the nest is quite undetectable from below. The young are clad in grey down, and when not actually being fed remain posed in a state of rigid immobility, most excellently camouflaged as a broken lichen-grown stub. In this they resemble the young of *Hemipus* and *Tephrodornis* which breed in similarly exposed positions and whose nests are almost though not quite so exiguous.

Caprimulgus macrourus : The Long-tailed Nightjar.

Occurs in the Inter-Zone, though I cannot speak for the other parts of the province. They may be distinguished from the other two Coorg nightjars by the darker plumage. They frequent downland and grazing grounds, spending the day roosting on the ground among the dead leaves in some thicket. The only nest I have found was in just such a situation in March. The sitting bird was so well camouflaged by her cryptic colouration that on returning to the nest a second time I stood within a yard without being able to see her, and until she flew off imagined that the eggs had been stolen. The two eggs are quite unlike the usual nightjar type. They are the normal shape, a regular oval equal at both ends. But in colouring they are a uniform pale coffee with small black spots. They are laid on the bare ground with no attempt at a nest. When returning after a disturbance, the bird would alight within a foot of the eggs and shuffle on to them. The young are clad in cinnamon down and almost from the moment of hatching are capable of crawling away and hiding under dead leaves, if frightened.

Caprimulgus indicus: The Jungle Nightjar.

The commonest nightjar in Coorg, particularly in the deciduous forest. They have a particular predilection for squatting on roads at night. Driving through the jungle after dark, one flushes dozens of them from the dusty surface, their eyes gleaming like rubies as they reflect back the headlights of the car. They breed in the open, in clearings in forest or on rocky outcrops. The nesting season is in March and April. Two eggs are laid, sometimes in the shade of a bush, but often right in the open on some rocky slope fully exposed to the blazing hot weather sun.

Caprimulgus asiaticus: The Little Indian Nightjar.

Very similar to the last species in habits, but confined to the Dry Zone where they abound in open scrub and cultivated country. They can be distinguished from the other Coorg species by their small size. They breed rather late in April and May, after the first showers. The eggs are laid usually on some stony outcrop, fully in the open.

Caprimulgus monticolus: Franklin's Nightjar.

Never identified, but may well occur.

Asio flammeus: The Short-eared Owl.

A rare visitor. The only ones I have ever seen were the twenty or so referred to by Sálim Ali in the Mysore Survey, at Hebbale in the Dry Zone in January. They were roosting on the ground at the foot of bushes at intervals of a few yards. I returned to the place on a number of occasions after Sálim Ali's visit, and the birds remained in the area for several weeks. Each retained its particular roosting spot where it could be flushed at any time through the daylight hours.

Strix indranee: The Brown Wood-owl.

This bird has been recorded from Coorg. I have not definitely identified it myself in the province, though it is a common bird in the Nilgiris.

Ketupa ceylonensis: The Fish-owl.

Found throughout the province, except in the Dry Zone, along streams and rivers and in the neighbourhood of swamps, preferably in forest. They rarely stray far from water. In a well-shaded locality they are more diurnal in habit than most owls. They appear to feed largely on frogs and crabs. I have not found the nest, but suspect them of breeding in hollows and forks of the huge wild mangoes and other large trees which abound along the banks of the Coorg rivers.

Bubo bubo: The Indian Great Horned Owl.

A very large horned owl is widely distributed, but nowhere numerous in the province. I had always put it down as *Huhua nipalensis*, but, in view of the findings of the Mysore Survey, it is likely to be this species. They are commonest in the deciduous forest. They are strictly nocturnal, spending the day perched in some thick, creeper-clad tree. When driving at night along a forest road, one occasionally sees them perched on a milestone or boulder by the roadside, presumably waiting to pounce on any rat or small mammal exposing itself on the public highway. Their call is a low, rumbling murmur. A pair used to frequent some large trees in my garden, and one could easily mistake their voices for those of two humans talking in an undertone.

Otus bakkamoena: The Scops Owl.

Never actually identified, but a very small owl which can hardly have been anything else used to visit my garden at night, and perch in a tree-top, uttering a double noted call for minutes together.

Athene brama: The Spotted Owlet.

Very common indeed in the Mysore 'maidan'. It occurs somewhat sparingly in the cultivated portions of the Coorg Dry Zone.

Glaucidium radiatum: The Jungle Owlet.

Fairly common in the deciduous forest, extending into the scrubby jungle on the edge of the Dry Zone. I have never seen it in evergreen country. The only nest I have found was in March, in a hole twenty feet up in a teak tree in light, open woodland. There were three eggs reposing on a musty smelling mass of pellets, largely composed of the fur and bones of mice. Both birds were in the hole so that it looks as if the male roosts beside his mate while incubation is going on. It is a comparatively diurnal bird, actively on the wing throughout the day except perhaps during the hottest hours.

Ninox scutulata: The Hawk-Owl.

Has been recorded, but I have never come across it myself.

Sarcogyps calvus: The King Vulture.

A regular resident, but never numerous. In the dozens of White-backs which gather round any dead bullock, one usually sees one or two birds of this species. They live up to their name and keep the others at a distance. I suspect them of breeding on some of the precipitous crags which rise up on the edge of the Dry Zone in the N.E. of the province, but I have never found an eyrie.

Pseudogyps benghalensis: The White-backed Vulture.

The common vulture of the province. At almost any time it is only necessary to scan the sky for a few moments to see one or more circling round at an immense altitude, and the carcase of any large animal left lying in the open attracts scores to the feast in a very short time. They squabble and fight over the carrion, braying like donkeys, and gorging themselves until almost too bloated to fly. I have not, however, been able to find any breeding colony in Coorg though there may be one somewhere on the forested cliffs of the Ghats.

Gyps fulvus: The Indian Griffon.

Gyps indicus: The Long-billed Vulture.

Neither positively identified, but they probably occur as I have met them in the Nilgiris, and Sálim Ali records them from Jog in the Mysore Ghats.[1]

Neophron percnopterus: The White Scavenger Vulture.

While numerically not so abundant as the White-backed Vulture, this is a much more familiar bird. The White-backs when not feeding spend their whole time soaring high in the sky, while the Neophron,

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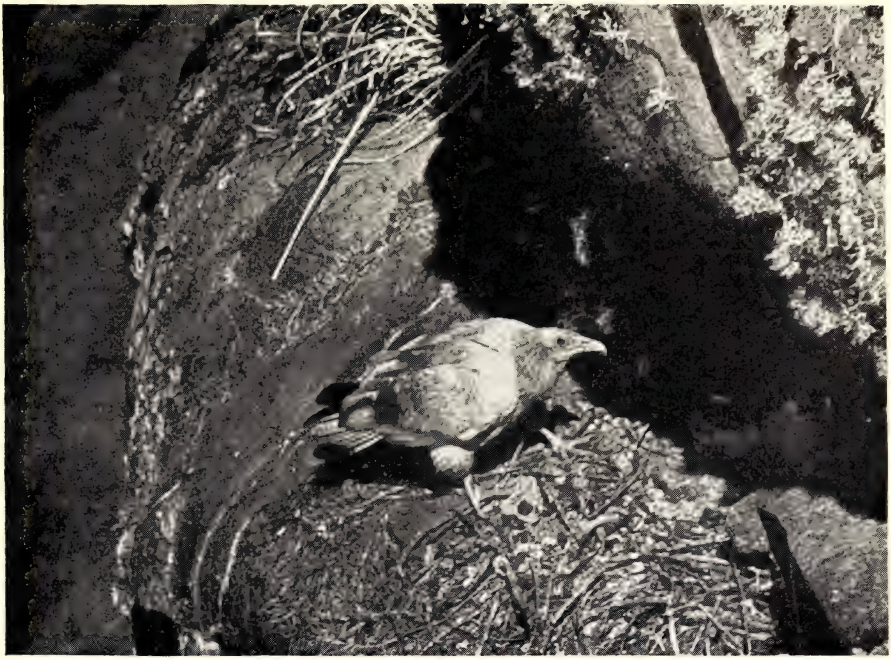
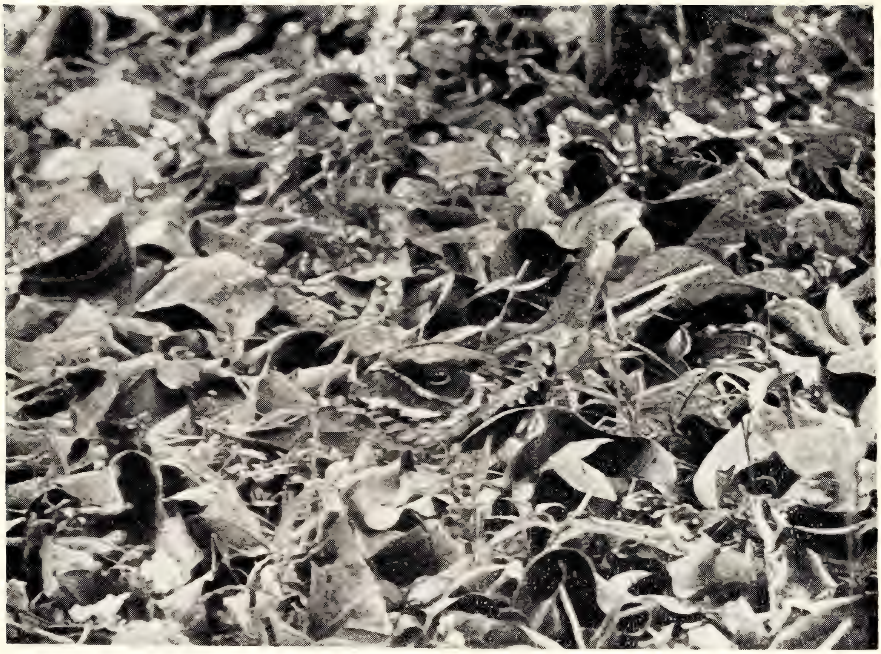
[1] See Correction on p. 236 of Vol. 45 of the *Journal*. The birds from Mysore were evidently all *indicus*. The record of *fulvus* was due to mistaken identification. Eds.



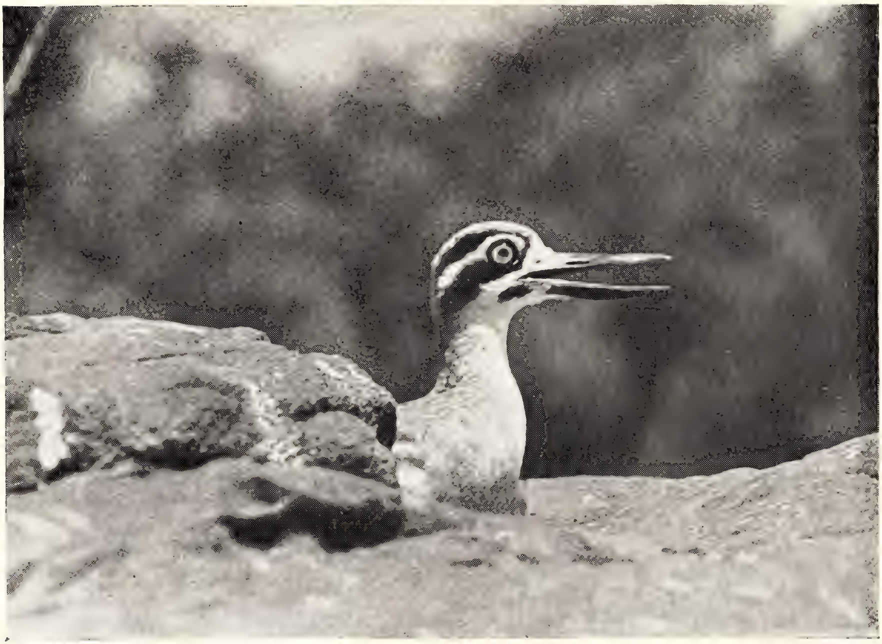
Egyptian Vulture.

Photos *Author*

Shahin Falcon.



Jerdon's Long-tailed Nightjar.



Photos *Author*

Great Stone Plover.

though a magnificent flier, passes much more of its life on the ground. They are unable to get a look in at the bigger banquets attended by their larger relatives, and have to work to obtain a living on the filth and scraps round villages, a large part of their food being human excrement. The towns and larger villages each support a number of pairs. I have been well acquainted for five or six years with one pair whose foraging ground is the little town of Somwarpet in N. Coorg. They bred annually on the rocky crag of Alikutty, 3 miles away, using a ledge on a cliff fifty feet high. The nest consists of a few filthy rags by way of a lining with bits of stick, bones and lumps of dung scattered round as decoration. In five consecutive years, one egg was laid on three occasions and two twice, but never more than one chick was hatched. The incubation period is a long one. The egg is laid in early February and the young bird does not leave the nest until the end of April. The sitting bird seems to be much troubled by parasites as is hardly surprising, and is continually pecking and scratching various parts of its anatomy. The young bird is fed at long intervals by either parent on scraps of carrion and other doubtful delicacies. Although such a dirty feeder it has some idea of sanitation, and at a very early age learns to scramble to the edge of the nest and void its droppings over the side.

Falco peregrinus [peregrinator Sundevall] **:** The Shahin Falcon.

Nearly every one of the higher, rock-crowned peaks along the line of the Ghats has its pair of these magnificent falcons, as well as several of the lesser hills along the ridge bounding the province on the N.E. Each pair seems based permanently on its particular stronghold though ranging over a wide area when hunting. The eyries are usually built on a ledge on some totally inaccessible precipice. The only one I know which is at all easily approachable is half way down a cliff some 150 ft. high on the Alikutty Rock referred to in my account of the Neophron, but half a mile away from the nest of the latter, at the other end of the crag. It is on a broad grassy ledge ten feet long by six at its widest, overhung by a jutting nose of rock. It is not hard to reach with the aid of a rope, but is well protected by swarms of the fierce Rock Bees whose combs hang from the rock-snout above. It was only when one year these had been smoked out by the Kurumbas, a local jungle tribe who are ardent honey-hunters, that I was able to get down. I found three eggs laid in a scrape in the grass with no attempt at a nest, on 15th February. On reaching the ledge it was found that I could not be pulled up again owing to the overhang, and I was marooned there for several hours while another rope was brought to allow me to go on down to the bottom of the cliff. Though I was sitting not a couple of yards from the eggs, the falcon returned within a quarter of an hour and brooded fearlessly, allowing me to move and take photographs. She was so close that I could hear her panting in the heat as she sat with open beak. At intervals she rose and stood over the eggs, shading them with half-spread wings. I never saw any prey being brought in, but judging by remains at the cliff foot, parakeets from a considerable portion of the food. The fledging period is prolonged and the eyasses are not on the wing until well into April. During the incubation period, the tiercel when not hunting kept watch from a neighbouring pinnacle.

Falco tinnunculus (objurgatus ?): The Indian Kestrel.

A resident subspecies of kestrel is found on the higher hills of the Ghats breeding in holes or ledges of the cliffs, usually in very inaccessible positions. I have never found an eyrie which could be reached without ropes and much labour. They breed early in the year. They are commonly to be seen hunting mice and beetles on the grassy downs of the Ghat summits, hovering in the usual kestrel manner.

Falco tinnunculus (tinnunculus ?): The European Kestrel.

A kestrel apparently rather larger and lighter in colour than the last is a widely distributed and fairly numerous winter migrant throughout the more open parts of Coorg.

Hieraëtus fasciatus: Bonelli's Eagle.

I have seen this eagle on several occasions, usually soaring high overhead in the Ghat country. On one occasion I obtained a close view of one feeding on the ground on a crow-pheasant which it had caught on the edge of a hill shola.

Hieraëtus pennatus: Booted Eagle.

Has been recorded from Coorg. Probably a scarce winter visitor.

Lophotriorchis kieneri: The Rufous-bellied Hawk-Eagle.

I have seen this bird on two or three occasions in light woodland country both in the deciduous forest and the Inter-Zone, usually not far from water. Its small size and rich colouration render its identification easier than that of most of the larger birds of prey.

Ictinaëtus malayensis: The Black Eagle.

A wide ranging species which turns up all over the province except in the Dry Zone. They are most often seen in the Ghat forests which I suspect are their breeding grounds. They are wonderful fliers. Their usual method of hunting is to float lightly as a butterfly on motionless wings within a foot or two of the forest canopy, or even lower among the boles and branches of the trees, avoiding obstacles in the most uncanny way, despite the great wing spread of five feet or more. They are silent birds except in the breeding season when courting couples swoop and wheel round each other in play with shrill yelping cries.

Spizaëtus cirrhatus: The Crested Hawk-Eagle.

Spizaëtus nipalensis: Hodson's Hawk-Eagle.

One or other, or both, of these eagles are regular residents in small numbers throughout the hillier and more well wooded parts of the province, but lacking specimens I have not identified them definitely.

Spilornis cheela: The Crested Serpent Eagle.

The common eagle of the province, found throughout the Ghats, the Inter-Zone, and the moister parts of the deciduous forest in well wooded, well watered country. Though a magnificent flier, and during the breeding season especially given to spending hours together soaring in circles, uttering its wild, whistling scream, it is on the whole more sluggish than many of the family, and passes most of its day perched on a prominent bough on the edge of some swampy forest clearing or jungle waterhole, ready to pounce on frogs and small snakes which form its usual food. I have never found an eyrie, but suspect it of breeding deep in the interior of thick forest.

Ichthyophaga ichthyaëtus : The Large Grey Fishing-eagle.

Occurs along all the larger rivers of the province. They are not very active birds, and though fine fliers seldom spend long periods soaring high in the air apparently purely for recreation as do so many eagles. They confine themselves strictly to the waterside, and will seldom be seen more than a very short distance from some river or tank. They feed almost exclusively on fish, which they catch by swooping from the wing, or more often from a perch on a bough overhanging the water. Fish up to several pounds in weight are captured.

The eyrie is a huge pile of sticks in a tall tree by the waterside. It is used for years in succession, being gradually added to until it reaches an immense size. Each pair seems to maintain two or three eyries within a mile or two of each other which are used more or less alternately. The breeding season begins in December at which time the birds are very vocal. Their cry is a weird, very loud, clanging succession of screams.

Butastur teesa : The White-eyed Buzzard.

Very rare in Coorg, and confined to the Dry Zone where I have once seen one near Hebbale.

Haliastur indus : The Brahminy Kite.

Found all along the larger rivers, particularly common in the Dry Zone, and somewhat less numerous on their upper courses through the deciduous forest and the Inter-Zone. Odd pairs, however, adopt the habits of *Milvus migrans*, and become parasitic on man, making a living by scavenging round towns and villages far from any large body of water. The jungle-dwelling birds feed largely on fish, frogs and crabs which they catch for themselves. They breed in February, making a substantial stick nest a couple of feet in diameter in some big mango or other evergreen tree at the waterside. Two eggs form the normal clutch.

Milvus migrans : The Pariah Kite.

Common round all the larger villages and towns, though their numbers are small compared with the myriads which haunt the plains villages in Mysore. As everywhere they are cowardly, scavenging birds, though wonderful fliers, and are a great pest to the poultry keeper, levying a heavy toll on young chickens and ducklings. They are very cunning, being well aware of the danger of a gun, and biding their time to make a sudden swoop when no one is looking. They breed in March and April, building a large stick nest usually high up in a tall, isolated tree, but sometimes quite low down. There is usually no lining, but sometimes leafy twigs or scraps of cloth are added.

Elanus caeruleus: The Black-winged Kite.

This graceful little kite is a regular winter migrant in small numbers. They are usually seen in open country such as the cultivated parts of the Dry Zone and the grass downs of the Ghats, but I have also found them in teak clearings and young plantations in the heart of the deciduous forest. They resemble the kestrel in their hunting habits, hovering on the wing, and swooping down on grasshoppers and field mice.

Circus macrourus: The Pale Harrier.

The harriers, except for males in full plumage, are difficult to distinguish in the field and I hesitate to be dogmatic about them. The present species does undoubtedly occur, but I cannot say how commonly as the old males which can be definitely identified are almost certainly greatly in the minority as compared with females and immature birds.

Circus aeruginosus: The Marsh Harrier.

This appears to be the most numerous species and is a common winter visitor all over the province, found everywhere except in forest country. They favour paddy fields especially, and swampy ground, where they feed on frogs. They do attack larger prey, however, and are a nuisance at duck shoots, making off with wounded birds often almost as big as themselves. That they will attack unwounded waterfowl seems unlikely as their presence is usually disregarded and does not cause the consternation evident when a Shahin Falcon or a Goshawk puts in an appearance at a tank.

Astur badius: The Shikra.

A regular and widespread resident, but in surprisingly small numbers compared to those in which it occurs in the Nilgiris in similar biotope. They are found equally in the Dry Zone and the Inter-Zone in fairly open but well wooded cultivated country. They feed largely on lizards, but also on small birds who regard them as deadly foes, and flee with shrieks of fear at their approach, or gather in indignant flocks to mob them. The only nest I have found was thirty feet up in a sapling in the deciduous forest, and was a small platform of sticks. There were three eggs in early April.

Astur trivirgatus: The Crested Goshawk.

Somewhat uncommon, occurring chiefly in forest in the Wet and Inter-Zones. Its method of hunting is to perch unobtrusively in a leafy tree and thence pounce out on some unsuspecting bird in one swift dash, pursuing relentlessly until it captures its prey or the latter escapes by going to ground in a thicket. The only nest I have found was in the Nilgiris in March. It was in a creeper-grown tree in the heart of an evergreen shola, at a height of thirty feet, and was a rough platform of dry sticks a foot wide, lined with green leaves, on which lay a single egg in an early stage of incubation. The sitting bird flew off silently and, though remaining in the neighbourhood, made no sound or demonstration.

Accipiter virgatus : The Besra Sparrowhawk.

Fairly common in the Inter-Zone and the deciduous forest. I have not seen it in Wet Zone evergreen forest, though it may occur there. It is a woodland species and the deadly foe of all small birds who realise this all too well and lose no opportunity of mobbing it if this can be done with safety. I have seen one capture a parakeet as big as itself, and watched another make an unsuccessful attempt on a three-toed Woodpecker. The latter gained a defensive position on a tree limb, and there ensconced and pointing its formidable bill to the enemy, drove off several attacks until the hawk gave up and retired in disgust.

Pernis ptilorhynchus : The Crested Honey-Buzzard.

I believe I have seen this bird in the Wet Zone in a Ghat shola, but it requires confirmation. It certainly should occur as it is fairly numerous on the Nilgiris in this sort of biotope, and Sálim Ali encountered it in Mysore.

Baza jerdoni : Legge's Baza.

An uncommon resident through the Inter-Zone and the eastern slopes of the Ghats where sholas and downland intermingle. Though I have not found a nest, it undoubtedly breeds as I have repeatedly seen pairs accompanied by juveniles which are easily distinguishable by their very pale colouration. The species is chiefly notable for its remarkable courtship flight. The pair soar round each other in circles high in the air. One of them then towers vertically for twenty or thirty feet, and, turning completely over, dives headforemost to its former level. Throughout the performance it utters a series of excited screams—'kip, kip, kip'. The demonstration may be carried out three or four times in a quarter of an hour. I have seen one with a captured lizard, and imagine that these and small mammals are their chief prey as they are slow on the wing and hardly seem sufficiently active to catch birds.

Crocopus phoenicopterus : The Southern Green Pigeon.

Not uncommon in the Dry Zone where it breeds. They wander up occasionally into the deciduous forest, and even the Inter-Zone when some particularly favourite fruit is in season there. They are entirely fruit-eaters living principally on banyan and other wild figs. A nest found in April was twenty feet up in an open thorny tree on the edge of a clearing in deciduous forest. It was an extremely flimsy and fragile platform of thin twigs insecurely balanced on the crossing point of two branches. There were two eggs.

Dendrophasa pompadora : The Grey-fronted Green Pigeon.

A common bird throughout the Inter-Zone and in the evergreen forest of the Ghats up to 4,500 ft. They are much more numerous than is generally realised as they are so wonderfully camouflaged. It is usually their sweet mellow, whistle which gives away their presence. Any large fig tree is certain to be visited when the fruit is ripe especially 'Gonis' and 'Basris'. Such a tree is sure to be alive with barbets, quarrelling and clambering among the outer branches. They are conspicuous enough, but there may be twenty or thirty pigeons in the tree whose presence will be quite unsuspected as they keep hidden among the leaves on the highest branches. Even if one knows they are there, one is lucky if after a prolonged search with binoculars one can pick out one or two.

I have not found a nest.

Ducula badia: Jerdon's Imperial Pigeon.

Strictly a Wet Zone species confined to the evergreen forests of the Ghats and extending up to the highest sholas. They are hard to shoot or even catch sight of, as they rarely emerge from the tree-tops except when flighting from one feeding ground to another. At these times they fly very high and strongly with slow, purposeful wingbeats. They are undoubtedly more numerous than one realises as one constantly hears their deep, moaning croon in the depths of the sombre forest. I have not found them breeding in Coorg, but on the Kudere Mukh in Mysore they were numerous in the sholas at 7,000 ft. in January, and evidently about to breed as courtship was in full swing. The courtship is of the typical pigeon type, in which the male advances along a bough towards his mate with bowed head and inflated throat cooing vigorously.[1]

Chalcophaps indica: The Bronze-winged Dove.

Another Wet Zone species, though found in small numbers throughout the Inter-Zone and occasionally in the deciduous forest. Their real home, however, is the heavy rain forest on the Malabar slope from plains level up to 4,500 ft. Here they are extremely numerous, and may be seen in numbers on roads running through the jungle especially round cart-stands where they pick up the fallen grain. At other times one usually meets them flying low and swiftly beneath the canopy of the forest. They are ground feeders. The call is a low, deep moan of several notes. I have not found the nest, though they undoubtedly breed in Coorg.

Columba elphinstonii: The Nilgiri Woodpigeon.

Has been recorded from the Brahmagiris in the extreme south of Coorg. Although I have never personally seen it in the province it probably occurs sparsely all along the Coorg Ghats as Sálim Ali found it both in the Billigiris to the south and the Bababudans to the north.

Streptopelia orientalis: The Rufous Turtle Dove.

Occurs in varying numbers as a winter migrant only. They are only to be found in the deciduous forest where there is plenty of bamboo, and mainly in the neighbourhood of rivers and the larger streams. In 1933, when large areas of bamboo flowered, they were particularly numerous and were feeding exclusively on the bamboo seed. They are very shy and difficult to shoot, and are generally in pairs, but occasionally in small parties. Their rufuous colouration serves to distinguish them in the field from the Spotted Dove.

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[1] For an account of the aerial display see Sálim Ali, *J.B.N.H.S.*, **39**: 338.

Streptopelia chinensis : The Spotted Dove.

Extremely common all over the province in all types of country except heavy evergreen forest and the windswept downs of the Ghats. They are entirely ground feeders like the rest of the genus, and live on grain and various wild seeds. One which I shot had its crop stuffed with the seeds of the Sensitive Plant (*Mimosa pudica*). They breed anywhere, often in the most ridiculously conspicuous situations such as a low, open thorn bush, within a yard of the ground and seldom at a height of over twenty feet. Nesting goes on throughout the year.

Streptopelia senegalensis : The Little Brown Dove.

Found only in the driest part of the Dry Zone, where it is common in cultivated country and light scrub jungle. It much resembles the last species in habits. They breed in some low thorn bush or skimpy hedge within a few feet of the ground. The breeding season is quite indefinite though most nests will be found after the first showers in April. Although built in such open situations, the nests are such flimsy little platforms of twigs and the incubating bird sits so closely that they are not conspicuous.

Streptopelia decaocto : The Indian Ring Dove.

Found only in the Dry Zone, but not so numerous as the last species. It is rather more a bird of the jungle, and will be found more commonly in the scrub-grown wastelands than in cultivation. Its call is a very distinctive one. One note at a distance sounds very much like a herd boy calling his cattle. The only nest I have found was in early March, well hidden in the interior of a small, leafy tree in thick scrub at about ten feet from the ground. It was the usual flimsy construction of sticks, and there were two eggs.

Pavo cristatus : The Peafowl.

Rather surprisingly the Peafowl is found throughout the deciduous forest belt often in quite thick woodland, though they prefer the neighbourhood of rivers where there are stretches of open maidan and big clearings. They do not, however, venture beyond the forest belt into the Inter-Zone. They are most at home in the scrub jungle of the Dry Zone where they are definitely common. They are extremely shy however, and though their caterwauling may be heard on any morning at sunrise, it takes very careful stalking to get a view. The way in which such large and highly coloured birds can hide themselves is amazing. They are usually seen in small flocks of six or seven, but one not infrequently comes on cocks by themselves. They emerge into the open to feed in the early mornings and evenings and spend the heat of the day resting in the heart of some impenetrable *Lantana* thicket. Unless flushed with dogs it is very hard to get them to fly, but when they do, even an old cock with his long, heavy train will rocket straight up out of the bushes and rise thirty or forty feet almost vertically to clear the treetops. They apparently breed in the monsoon, probably about June, as though I have not found a nest, I have on a number of occasions seen families of young the size of domestic fowls in August.

Gallus sonnerati : The Grey Junglefowl.

Despite constant persecution by gun and snare, the Grey Junglefowl is found in some numbers all over the province in forest land. They exist even in the heart of the Wet Zone evergreen forest, a habitat shunned by many other almost ubiquitous species. They ascend the Ghats to the highest sholas, and also frequent the thin, scrub jungle of the Dry Zone wastelands. They are commonest of all in the deciduous forest, and in the Reserves, where the Forest Department can exercise some control over shooting and trapping, are really numerous. In the dry weather, from January to April in this region, the crowing of the cocks may be heard on every side. They are to some extent migratory on particular occasions. The flowering of the *Strobilanthes* undergrowth in the Ghat sholas which occurs every seven years or so, attracts very large numbers to the hills, and the same applies when the bamboos flower in the deciduous belt. The breeding season varies somewhat with the locality, from January to March in the Wet Zone, and later, in April and May in the Dry Zone where they wait for the first showers to put an end to the forest fires and start a growth of vegetation. The nest may be anywhere on the ground, usually under a bush. The clutches are small, two or three eggs only. The cocks appear to be polygamous and take no interest in the rearing of the brood.

Galloperdix spadicea : The Red Spurfowl.

While very like the junglefowl in range and habits, this species is even more widely distributed, as it is by no means confined to uninhabited country, but is numerous in coffee plantations, and any patch of *Lantana* or woodland of any size even close to villages. Despite this they are shy birds, scuttling away into the undergrowth if disturbed, and very seldom seen in the open except after the paddy harvest when numbers may be seen of an evening in any field bordering on forest. When flushed by a dog, they fly up into the trees, and, crouching motionless on a lofty bough, are very difficult to pick out. The junglefowl has the same habit. Unlike the junglecock, the male spurfowl leads an exemplary married life. He lives with his single wife throughout the year and is a devoted father, though I do not know whether he shares in incubation. If one disturbs a brood of young chicks, both parents become quite distracted and try to draw off one's attention by floundering about as though *in extremis*, while the young freeze among the dead leaves where their cryptic colouring makes them almost invisible. Breeding takes place early in the year, from late February till April. No nest is made, the eggs being laid in a scrape usually on sloping ground among a drift of dead leaves under a bush. The hen is timid and deserts easily. The normal clutch is two eggs only. The call is a long loud, bubbling rattle.

Excalfactoria chinensis : The Blue-breasted Quail.

I once flushed a very small, very dark quail in long grass on the edge of a paddy field. I failed to shoot it, but it was undoubtedly a new species to me, and would seem likely to have been this bird.

Cryptoplectron erythrorhynchum : The Painted Bush-Quail.

Common throughout the Wet Zone wherever there are considerable stretches of long grass on the borders of paddy fields, especially those abandoned or fallowed. It is also found on the grass downs of the Ghats. It does not occur in the Dry Zone or far into the deciduous forest. The birds live in bevies of considerable size, a dozen or more individuals. I have never found the nest in Coorg, but in the Nilgiris one that I came on in September was a small pad of grass in a patch of long grass on the edge of a shola. The young had hatched, leaving one addled egg, unmarked and whitish in colour. The normal breeding season is evidently in August and September, after the worst of the rains are over, and the grass has attained a good height. The cock at this time becomes very vocal, constantly reiterating his sweet double call-note. The clutches must be large as one sees up to ten or more young with their parents, who are both most devoted. The chicks can fly at a very early age, even when they are still down-clad mites scarcely bigger than bumble-bees.

Perdicula asiatica : The Jungle Bush-Quail.

Replaces the last species in the Dry Zone where it is very common both in the scrub and in cultivation. They are found in considerable bevies, not quite so large as those of the last species, but from six to ten is a normal number. In the dry season they keep mainly to the scrub, but as soon as the young corn begins to give cover in the 'ragi' fields in June, they flock thither, and though I have not found a nest I suspect that this is where they breed. Eggs must be laid in early July as the young are well grown by the time the 'ragi' is reaped in August.

Francolinus pondicerianus : The Grey Partridge.

Occurs in considerable numbers in the open cultivated area of the Dry Zone, and the patches of wasteland grown with thin scrub which occur therein. Though shy, one comes on them quite close to villages and they are said to be very dirty feeders, though I cannot confirm this. They pair in January and early February at which time the cocks become very vocal and pugnacious. In fact partridge fighting is a favourite pastime of the local inhabitants, and numbers of birds are snared for the purpose. Breeding appears to start with the first rains in May or June, and the five or six young remain in the covey until the following pairing season.

Turnix suscitator: The Common Bustard Quail.

Occurs in the Dry Zone, though by no means common. I have seen one solitary bird shot there.

Rallus eurizonoides : The Spotted Crake.

The only occasion on which I have met this species was on a hill-side in the deciduous forest in thick bamboo jungle, a long way from water. I was in hiding by a game trail when a family party came by, and passed unsuspectingly within a few feet. It was a charming spectacle. One parent led the way, the picture of caution and alertness, peering this way and that as it picked its way along, constantly jerking its tail to display the bright rufous under-tail coverts. Behind, two little chicks, clad in black down, stumbled through the dead leaves, while their other parent followed behind shepherding them along if they showed signs of dawdling. This was in September.

Amaurornis fuscus : The Ruddy Crake.

A water-loving species which I have never seen except on the borders of flooded paddy fields or round tanks. Common round the big tanks in the Mysore maidan where there are reedy margins. The only record I have for Coorg is one flushed in a bed of bulrushes growing in a small tank in the Dry Zone. They swim freely and even dive when wounded, if chased.

Amaurornis phoenicurus : The White-breasted Waterhen.

Common throughout the province in paddy fields and in the neighbourhood of any permanent standing water such as the ponds which are maintained by every coffee estate to supply water for washing and pulping the crop. Though perfectly capable of swimming, they do not do so unless it cannot be avoided, and seek their food on the marshy margins, never very far from some thicket or clump of bushes into which they scuttle for cover on any alarm. They perch freely, clambering up the trees to a considerable height. I have not found a nest, but it would appear that they breed during the monsoon as I have seen a pair in attendance on a couple of downy young in late July. Though normally silent, they give vent at times to the most appalling catcalls of astonishing volume.

Gallinula chloropus : The Indian Moorhen.

The only place in Coorg where I have seen this bird is Halagote Tank, where it is a breeding resident except when, as happened in '38/'39, a succession of short monsoons caused the water almost to dry up and killed the reeds. Two or three pairs ordinarily nest there and remain throughout the year, but their numbers are greatly augmented in the winter by migrants. I have seen as many as fifty or sixty in December. They are indistinguishable in the field from the British bird. Nests which I have found have been substantial floating masses of bulrush leaves anchored to a reedstem, and built up seven or eight inches from the water with a deep, well-formed cup on top. Five or six eggs are laid in July, by which time the tank is or should be full and the reedbeds providing plenty of cover.

Fulica atra : The Coot.

A winter migrant, visiting Halagote Tank in varying numbers.

Porphyrio poliocephalus : The Purple Coot.

A dozen or so of these birds normally inhabit Halagote Tank more or less permanently, though they were absent in the drought years of '38/'39. Their status is somewhat puzzling as though one or two are to be seen even in July which is presumably their breeding season, I never succeeded in finding a nest nor saw young birds. It would appear that they go elsewhere to nest and that those that remain are non-breeding specimens. Though entirely water birds and rarely seen on land, they avoid open water and do not swim if they can help it. Their whole life is spent clambering about in the reedbeds or wading on the matted beds of floating waterweed. They are noisy, ill-tempered birds with loud, harsh voices, and are continually quarrelling and chasing each other about.

Metopidius indicus : The Bronze-winged Jaçana.

In normally wet years this species occurs in numbers on Halagote Tank, but as with the last its status is uncertain, since though I visited the tank in all months of the year and have nearly always found them present, I have never been able to find a sign of eggs or young. They resemble the Purple Coots in habits, but are much more active, running rapidly over the floating weeds and taking wing freely, though in the air they look extremely clumsy with their legs trailing awkwardly behind them. They are extremely noisy birds with a variety of trumpeting and braying calls.

Rostratula benghalensis : The Painted Snipe.

Common in the Mysore 'maidan' round tanks with extensive reed-beds. In Coorg they are scarce though one occasionally comes on an odd bird while out snipe shooting. Their favourite haunts are the thick patches of *Pandanus* which are found at the head of most stretches of paddy land in the Inter-Zone. Where there is one bird, there are likely to be five or six. They sit very closely, and when flushed rise singly and silently and never fly far. They probably breed in the province, though I have not found a nest.

Burhinus oedicnemus : The Stone-curlew.

Occurs in the Dry Zone, and is also thinly distributed through the deciduous forest and the Inter-Zone wherever there are patches of downland or jungle clearings, of considerable size, where the grass is kept short by grazing and which include patches of scrub for cover They are shy birds, largely nocturnal in habit. Throughout the day-time they lurk in the shelter of a bush, but at night are active on the wing, and their wild cries can often be heard as they pass overhead in the darkness from one feeding ground to another. They are on the whole sedentary, each pair living through the greater part of the year in their breeding territory. Eggs are laid in February. The clutch is two and there is no attempt at a nest or even a scrape. They are deposited among dead leaves under some small isolated tree. Although usually laid in the open, there is always some thick cover close at hand into which the bird can slink on the slightest alarm, with the result that it is extremely hard to discover her secret. I have not been able to detect whether the male shares in the incubation, but he is never far away and keeps a constant watch for enemies.

Esacus recurvirostris : The Great Stone Plover.

A bird of the lower reaches of the larger Indian rivers. In Coorg two or three pairs only may be found within the provincial boundary, on the Cauvery where it flows through the open cultivation of the Dry Zone. They are to be found in stretches where the river widens and runs among boulders and bare, rocky islets. Although like other

Stone Plovers they are really nocturnal birds, feeding and becoming active at night, they are by no means shade lovers and spend the day drowsing in the full glare of the sun on some baking rock. They breed in February, and the two eggs are usually laid on a patch of sand or gravel within a foot or two of the water on a ledge of a slab or rock in mid-stream. The same site is used year after year. The birds are not shy, brooding unconcernedly while bathing, watering of cattle, and all the activities of Indian village life go on along the shore a few yards away. Incubation throughout the day at any rate is of necessity very close as the nesting site becomes so hot that were the eggs left uncovered for more than a few minutes at a time, they would certainly be cooked. I cannot say whether both birds share in brooding, but it seems likely as the strain in such heat must be severe. They feed chiefly on crabs, and possibly frogs and tadpoles, their strong recurved bills being admirably adapted for prying under stones of some size. The cry is a loud creaking note, not at all like the 'curlew' call of the common Stone Curlew.

Sterna aurantia : The Indian River Tern.

A few pairs are to be found in the same locality as the last species, that is along the Cauvery in its lower and more open reaches where it runs through the Dry Zone on the Mysore border. Each pair occupies a long stretch of water, and they strongly resent trespassing on the part of others of their own species, birds of prey, and any unusual humans or animals, especially in the breeding season. They swoop round the intruders, screaming angrily. They are exclusively fish-eaters, catching their prey in the normal tern manner by plunging from the wing, very rarely settling on the water or swimming. Breeding goes on from March to May. The eggs are laid without any sort of nest in a hollow of a rock in mid-stream and number two or three. The young when hatched are clad in grey down and can hide themselves in an amazing manner simply by squatting motionless fully in the open on their home rock. They are fed by both parents till they are well on the wing.

Sterna melanogaster : The Black-bellied Tern.

I have seen birds of this species occasionally along the Cauvery in the same area as the last, but they are by no means so common and I have not found them breeding.

Charadrius dubius : The Little Ringed Plover.

A few of these little plovers may occasionally be seen along the lower reaches of the Cauvery in the Dry Zone and I have seen one or two on the shores of Halagote Tank. All my records have been in March, and I am uncertain whether they are likely to be the resident or the migratory race. I have not found signs of breeding. They haunt sandbanks and sandy stretches along the shore, but occasionally may be found on bare fallows or 'maidans' some way inland.

Lobivanellus indicus : The Red-wattled Lapwing.

Extremely common all along the larger rivers both in their forest reaches and the open country lower down, but especially in the latter.

They are essentially waterside birds, and though one occasionally sees them on 'maidans' and forest clearings in the deciduous forest and the Inter-Zone some way from the river, they are only temporary visitors in these places. They spend the day standing about, drowsing on rocks in the stream, and only become active in the evening and during the night, especially when there is a moon, at which times their calls may be heard overhead in places where they are never seen normally. The breeding season is in February and March. Oddly enough in my experience though an occasional nest may be found on an islet in the river, the great majority leave the waterside at this time and go inland for up to a mile to some secluded clearing in the jungle or a ploughed field, if in cultivated country. The four eggs are laid in a scrape in the ground, sometimes with a slight lining of small pebbles or bits of dried cowdung. Until the eggs hatch, the birds are very secretive. On an alarm, the sitting bird slips off the nest and runs to a safe distance and then both she and the male fly right away in silence. After hatching however their tactics change completely. Any intruder is greeted with shrieks of abuse, the old birds flapping and swooping round his head, or flopping frenziedly along the ground as though seriously wounded.

Lobipluvia malabarica : The Yellow-wattled Lapwing.

I have only come on this bird at one spot in Coorg, the Belur Golf-course near Somwarpet, some 200 acres of downland lying on the borders of the deciduous forest. Here two pairs lived for five years between '35 and '40 when I left the district. They appeared annually about Christmas and stayed until the break of the monsoon. They attempted to breed the first two years, but only managed to raise one brood out of four and in subsequent years do not appear to have nested though I kept a constant watch on them. The clutch was four. All four nests were within a few yards of the same spot, fully exposed on short grass in the middle of the fairway, and they were not inconspicuous, being quite substantially lined with bits of grass and dried cowdung. The first year, however, when they raised a brood, the eggs were of the normal colour and blended well with the surroundings. In subsequent years the male must have got a new mate, as the eggs were of a bright erythristic type, contrasting vividly with the olive green turf, and they were taken almost as soon as laid. It is of interest to note that Belur is only some sixty miles from the red laterite plains of the Malabar coastal belt where apparently this species regularly lays erythristic eggs which match well with the surrounding soil. All nests I have seen were in March. These lapwings are quiet birds compared with the last species and do not require the close proximity of water.

Himantopus himantopus : The Black-winged Stilt.

I saw three birds, my only record, at Halagote Tank on 9-1-39, a dry year when the tank was reduced to a mere puddle of muddy water in which the birds were wading thigh deep. One comes on them quite frequently on the big tanks in Mysore.

4

Tringa ochropus : The Green Sandpiper.

A common winter visitor both in the Dry and Inter-Zones. They are to be found wherever there is water and open country on the shores of tanks, paddy fields, and along streams, usually singly. They arrive in September and leave late, some lingering till May.

Actitis hypoleucos : The Common Sandpiper.

The earliest winter migrant to Coorg, arriving before the end of August. It is entirely a waterside species, found on all the larger rivers both in their forest reaches and lower down in open country, but nowhere in large numbers. Usually a pair is the most that will be seen together. They also appear on the shores of Halagote Tank and the big Mysore tanks.

Tringa glareola : The Wood Sandpiper.

A waterside species found in large numbers in winter on the shores of all the big Mysore tanks. In Coorg, Halagote Tank is the only place where I have seen them, especially in dry years when large stretches of open mud are exposed. Unlike the Green Sandpiper, they do not like reeds or swamps grown with long grass, and they are much more sociable than that species.

Scolopax rusticola : The Woodcock.

Probably occurs regularly in small numbers as a winter migrant, haunting the cardamom plantations and evergreen sholas on the eastern slopes of the Ghats above 4,000 ft., as it is well known in Mysore in such country. The only one, however, that I have actually seen in Coorg was a stray on the banks of a stream running through coffee near Somwarpet at 3,500 ft. In Mysore they are very conservative in their habits. On an estate near Chikmagalur with which I am acquainted, half a dozen or so are to be found every year in one particular small ravine and nowhere else.

Capella gallinago : The Fantail Snipe.

Recorded from Coorg, but nowhere numerous. It is much commoner in Mysore round reed-grown tanks in the 'maidan'.

Capella stenura : The Pintail Snipe.

The common snipe of the province found in considerable numbers in winter, varying according to the water available. They occur wherever there is suitable feeding ground, in the shape of swampy, fallow paddy fields. They like the soil to be soggy but without actual standing water, and the grass must not be more than three inches long. Strangely enough they will rarely be found in flooded standing paddy, a favourite haunt on the Malabar Coast. They feed mostly in the morning and evening, and very often spend the day in any jungle, especially screwpine or lantana, adjoining their feeding grounds. They arrive early in September and leave in April.

Capella nemoricola : The Wood Snipe.

I was shown a specimen shot near Mercara on 28-1-38 and another obtained just over the Mysore border, near Somwarpet. These are the only two records for the district.

Phalacrocorax niger : The Little Cormorant.

Occurs on the larger rivers. It is common on the Cauvery in its lower reaches on the Mysore border, and occasionally wanders some way up into the forest stretches. It does not breed in the province. All those found there probably drop downstream to nest at the big heronry at Palhalli near Seringapatam.

Anhinga melanogaster : The Darter.

Found singly and in small numbers all up and down the bigger rivers well up into the forest reaches. Unlike the cormorant which usually chooses a rock, the darters frequently perch in trees, choosing a thick one overhanging the water from which they can watch for their prey. Like the last species they breed at Palhalli during July and August.

Anastomus oscitans : The Open-billed Stork.

Occurs occasionally on the wide, open reaches of the Cauvery in the Dry Zone below Fraserpet, usually singly but sometimes two or three together. These also breed at Palhalli.

Dissoura episcopa : The White-necked Stork.

I have once seen a pair in Coorg, and one or two others just over the Mysore boundary, in all cases in wild, uninhabited, open scrub country.

Ardea purpurea : The Purple Heron.

This bird is only to be found in the neighbourhood of tanks in which large, dense reedbeds grow. One may often see a solitary bird at Halagote in wet years when the reeds are tall, and also at another small and very reedy tank nearby. They are shy birds. Their great height enables them to see over the reed tops, and pick out any approaching danger, when they do not freeze like the Bittern, but take wing with a great fluster, and fly off croaking harshly. A small colony nests at Palhalli, not on the main island among the other birds, but on a separate islet covered with *Pandanus*. The nests are in the heart of the *Pandanus* tops and quite invisible from outside. The breeding season is from July to September.

Egretta alba : The Large Egret.

Egretta intermedia : The Smaller Egret.

Egretta garzetta : The Little Egret.

All three egrets occur sporadically round Halagote and the other small Dry Zone tanks, also on the lower reaches of the Cauvery. *E. alba* and *E. intermedia* are much less common than *E. garzetta* The Large Egret is generally solitary, the other two are occasionally found in small flocks. Though common in flooded paddy fields in Mysore, in Coorg they are confined to the Dry Zone and are not found in the paddy cultivation of the Wet Zone or the deciduous forest belt. All three breed during the rains at Palhalli.

Bubulcus ibis: The Catte Egret.

Commoner than any of the last three though confined to the Dry Zone where it occurs in small flocks along the lower Cauvery and also round tanks. Unlike the other egrets they wander considerable distances from water, attending on herds of cattle and buffaloes, picking the ticks off the grazing animals and pouncing on insects disturbed by them. Like the other egrets they breed at Palhalli in the rains.

Ardeola grayii: The Pond Heron.

Common throughout the province wherever there is water, whether paddy fields, ponds, pulphouse reservoirs, tanks and along the main rivers. I suspect them breeding on occasion in Coorg having seen a juvenile apparently too young to have come far on a stream near Somwarpet. But the great majority depart in the early rains. The only certain breeding place I have come across is Palhalli, where a comparatively small colony builds on the fringe of the main heronry in some clumps of screwpine, but these cannot represent a fraction of the total population of Coorg and the surrounding parts of Mysore, and there must be other breeding grounds. The very handsome breeding plumage is only assumed for a short time, and all those one sees in Coorg are in the drab plumage of the off-season.

Butorides striatus: The Little Green Heron.

Occurs in small numbers along forest streams and rivers with shady banks overhung with trees. Here it is found singly, lurking under a steep bank or in the lower branches of a thick bush over the water. On being disturbed it flies silently away for a hundred yards or so, and settles in cover once more. I once found the remains of one which had been killed and was being eaten by a hawk-eagle. They appear to be resident and probably breed in their usual haunts though I have not found a nest. They do not breed at Palhalli.

Ixobrychus cinnamomeus: The Chesnut Bittern.

Found in small numbers widely spread over the province. An extremely shy, skulking bird usually only encountered out snipe-shooting when singletons are occasionally kicked up out of long grass on the banks of streams or from reedbeds near ponds and small tanks.

Ixobrychus sinensis: The Yellow Bittern.

My only record for Coorg is of a pair which I found breeding in September in a bed of bulrushes growing in a small tank a couple of acres in extent in the Dry Zone near Hebbale. The nest was formed from the tops of a number of reeds, bent over and roughly interwoven at a height of four feet from the water. There were five eggs. Sálim Ali does not record the last three species from Mysore, but they must undoubtedly occur.

Nycticorax nycticorax: The Night Heron.

An occasional stray bird wanders up the Cauvery into Coorg. It is a common species in the irrigated areas of Mysore, breeding in very large numbers at Palhalli.

Nettapus coromandelianus: The Cotton Teal.

A regular frequenter of Halagote Tank. A couple of dozen birds are always to be seen there in normal years though in the drought seasons of '38/'39 they disappeared. Though they seemed to remain there throughout the year I could never find any trace of their breeding. Occasionally an odd bird may be seen on the Cauvery, but they are essentially birds of stagnant, not running water.

Dendrocygna javanica: The Lesser Whistling Teal.

The notes on the last species apply equally to this one. In normal years a few pairs are always to be seen at Halagote, but they do not seem to breed there. They will only be found on tanks with a heavy growth of reeds and water-lilies, and avoid open water.

Podiceps ruficollis: The Little Grebe.

Found on all the small tanks in the Dry Zone and occasionally, though uncommonly, on the Cauvery. At least fifteen pairs inhabit Halagote Tank normally, and even in the drought years when the tank was reduced to a muddy pond, a bare hundred yards in length, a few remained. They begin to breed in June as soon as the new growth of reeds is well established. The nests are floating masses of water-weed in a decayed and fermenting condition, which provide a regular hot-bed for the eggs and prevent them chilling though they are always soaking wet. Breeding goes on until the end of August and there seem to be at least two, if not more broods. The usual clutch is four. The sitting bird always covers up the eggs before leaving the nest. On an alarm she does this with a few swift movements of the beak, and then dives silently over the edge, coming up some way off and creating a great splashing and disturbance to attract attention from the nest. The hen alone seems to feed the young. The latter can swim as soon as hatched, but take some time to learn to dive. One may see a parent feeding chicks which swim about in great agitation whenever the old bird goes under until she reappears.

THE HILSA FISHERY OF THE CHILKA LAKE[1]

BY

S. JONES AND K. H. SUJANSINGANI,

Central Inland Fisheries Research Station, Barrackpore.

(*With 2 plates, 3 graphs and 3 text figures*)

INTRODUCTION

During the fisheries investigations in the Chilka Lake (Fig. 1), from where the city of Calcutta draws an appreciable part of its fish supply, certain observations were made on the biology and fishery of the Indian Shad, *Hilsa ilisha* (Hamilton), which are detailed below. According to

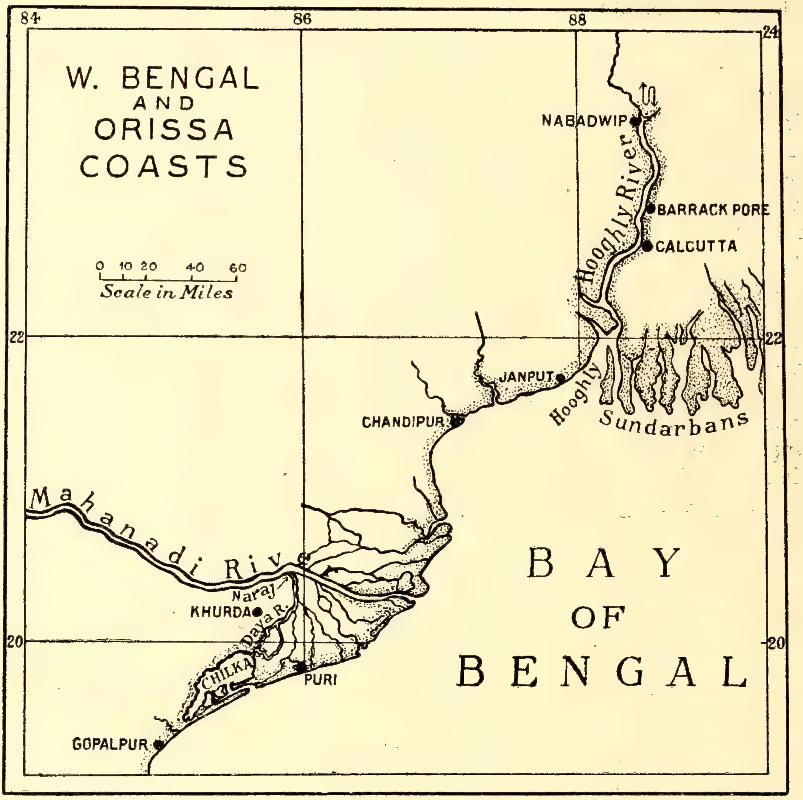

Fig. 1. West Bengal and Orissa coasts, showing the Chilka Lake and other centres of observation. The arrow indicates the position of the Naraj Anicut.

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[1] Published with the permission of the Chief Research Officer, Central Inland Fisheries Research Station, Barrackpore.

the figures collected by the Orissa Fisheries Department, 3443 maunds[1] of fresh hilsa fish were exported by rail in the year 1948 and 1255 maunds in 1949, out of the total export of 71,400 maunds and 61,100 maunds of fresh fish during the respective years.

In view of the low economic standard of the local people and the high price obtained for the fish at Calcutta, almost the entire catches of hilsa are exported, and thus the above figures represent over 95% of the hilsa yield from the lake for these years. The available statistics show considerable variations in exports from month to month in different years, on account of great fluctuations in the catches from the lake, and it is necessary to study the statistics for a number of years to be able to explain the cause for fluctuations in the fishery.

The Chilka is a large brackish-water lake, in the deltaic region of the Mahanadi, extending over an area of about 450 square miles during the monsoons and about 350 square miles for the rest of the year. In the east, it is connected to the Bay of Bengal by means of a narrow bent channel, about 14 miles long and in the northern section it receives flood waters from the Daya, a branch of the Mahanadi. The lake is very shallow, except in the southern sector, where it is somewhat deep. The fish fauna, which is mainly estuarine in composition, gets continuously replenished from the sea and its consequent elements at any one time largely depend on the salinity and other general hydrological conditions which vary from season to season, both in the lake and the channel. In the summer, the main area of the lake is distinctly brackish, whereas at the end of the monsoons a great part of it is fresh and the change from the water of low to that of comparatively high salinity takes place by the ingress of sea water through the channel. The hydrological conditions in the lake are mainly influenced by the flood waters of the Daya. Lying north-east close to the lake is a chain of hills which leaves only a narrow stretch of catchment area, giving rise to a very few small streams that drain into the lake during rains. The effect of the local rainfall thus being not appreciable, the cyclic change from brackish to fresh water in the lake depends almost entirely upon the flow from the Daya, as the flood waters not only check the ingress of sea water through the channel but also gradually push out the brackish water and the Chilka becomes a fresh water lake.

FISHERY

Hilsa is fished in the Chilka throughout the year and the figures shown in the tables I and II throw some light on the relative abundance of the fish in the different parts of the lake. Though the catch is dependent on various factors and the occurrence of the fish near the different centres may not necessarily be proportionate to the export figures recorded from those centres, it is obvious that the fish does not occur in appreciable quantities in the southern sector, i.e. south of Balugan where the salinity is generally higher, and is available in greater abundance in the northern section, i.e. towards Kaluparaghat side. In the ordinary course, the fish is exported from the centre nearest the fishing ground and as such generally the fish caught near Parikud and between Parikud and Satpara is exported from Balugan [Plate 1 (1)]. The catches from the Satpara side are however exported from Balugan as well as Kaluparaghat, as both the centres are more or less equidistant, whereas, most of the catches from Tuaside and beyond in the north, are diverted to Kaluparaghat. Exports from Gangadharpur and Kuhuri consist mainly of the catches round about these centres, though occasionally some catches from Gangadharpur are diverted to Balugan also. In the bay near Rambha and Kallikhota, there is not much of hilsa and the catches are exported from the nearest centre.

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[1] 1 Maund=82.28 lb.

Fishing methods. Gilling nets are used for the purpose of catching hilsa by encircling, and these are locally known as 'Bhid Jal', 'Garoa Jal' and 'Patua Jal' [Plate 1, (2 and 3)]. Strictly speaking 'Patua Jal' is not operated as a means for catching hilsa, but accidentally the fish gets caught in the net, when the latter is operated for catching 'Patua' (Engraulid) fish.

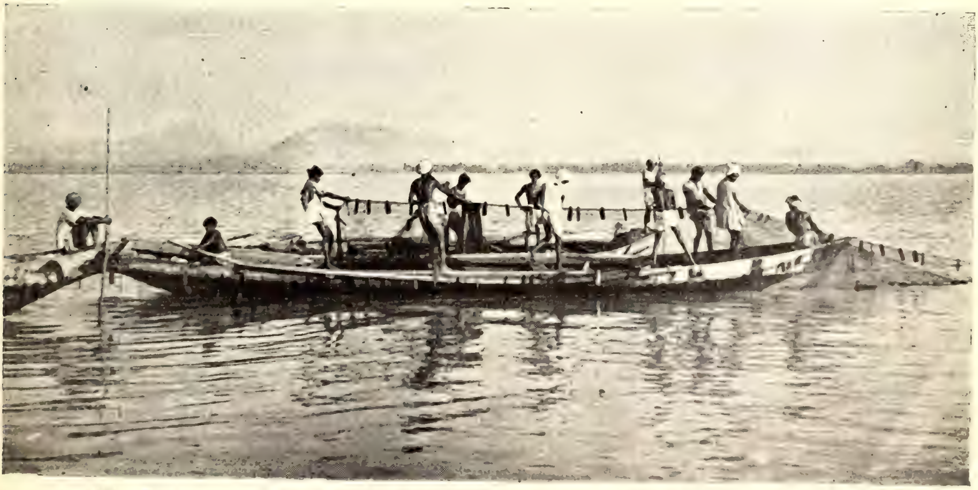
Fish trade. As the fish fetches fairly high price outside the province, it is rarely salted and that also only in the remote fishing centres, from where it is difficult to transport it to the exporting centres in time. At times lack of ice and persistent bad weather, specially in the monsoon season, necessitate the salting of the fish, but otherwise the fishermen export it through co-operative societies [Plate II (1)] or merchants who hold permits for export outside the State of Orissa. Fish is packed in bamboo baskets [Plate II (2 & 3)] one maund in each, with about a maund of well-crushed ice. An advance against the weight of the catches tendered for sale, upto the Civil Supplies rate of Rs. 32 per maund of 40 seers is paid to the fishermen, if required, at the time of delivery, and the account is finally settled on the basis of the 'chalans' received from the market where the fish is auctioned or otherwise disposed of. A deduction of about Rs. 16 per basket of one maund of fish is made from the rate shown in the 'chalan' towards export duty, transport, cost of ice and other incidental charges. For the fish exported to Calcutta, the fishermen get roughly Rs. 45 to Rs. 50 per maund, though the sale price there generally varies between Rs. 80 and Rs. 100. It may be mentioned here that the Chilka hilsa fetches a lower price than the Ganges hilsa, which is received in better condition and consequently is in greater demand.

SEASONAL FLUCTUATIONS AND CROP MOVEMENTS IN RELATION TO PHYSICO-CHEMICAL CHANGES

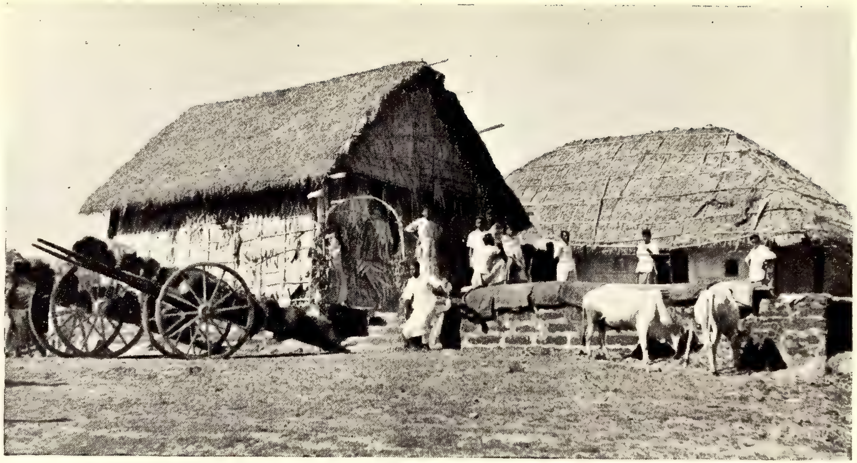
The export figures for 1948 and 1949 given in tables I and II, which are very nearly equivalent to the catches from the lake in these years, as there was no difference in the fishing conditions or the local demand, indicate the presence of two peak periods, which obviously correspond to two main waves of migration of fish (Graph I) into the lake, one at the close of the winter and the other at the commencement of the monsoons. In the Hooghly also there are two periods of migration, one by about February, i.e. at the close of the winter, and the other with the onset of the monsoons. Though statistics of

(1) A view of Balugan, one of the main fish assembling and exporting centers in the Chilka. Fish is being unloaded from the country boats seen in the foreground

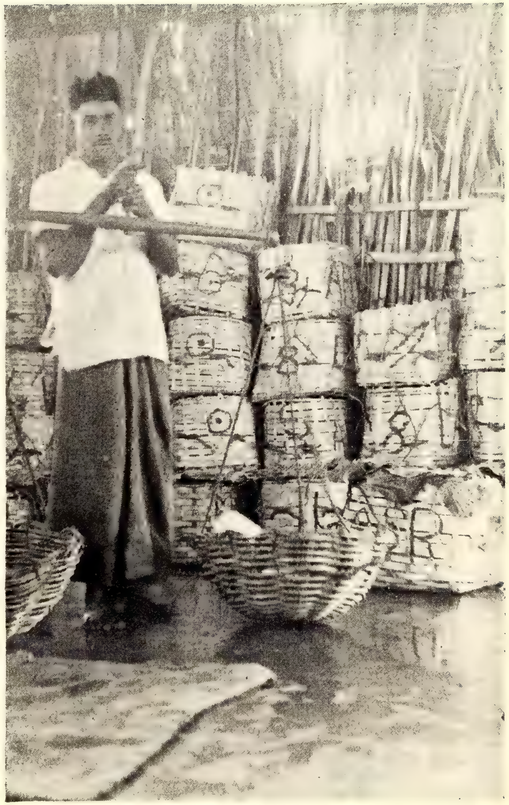
(2) A view of the gilling nets in operation, in which hilsa is caught



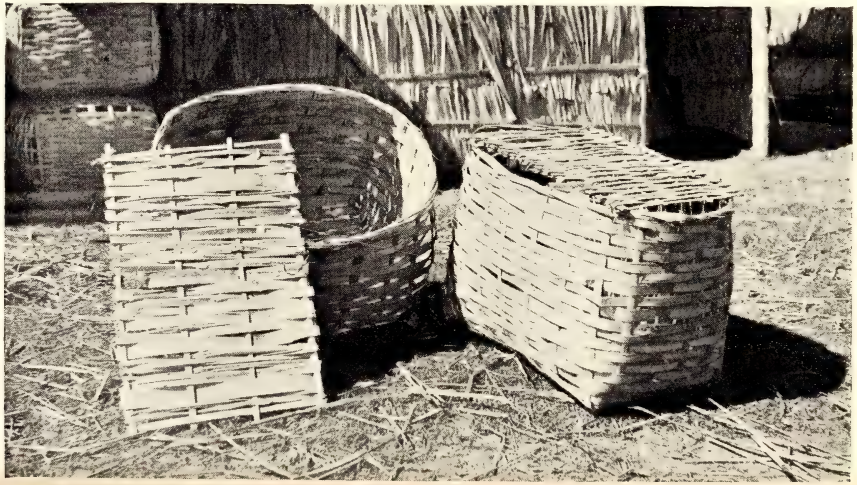
(3) Stacking the net in boats and collecting the gilled fish as they come in.



(1) A view of the Ambica Fishermen's Co-operative Society, Balugan, with their offices in the background and fish godown in the foreground, where a large number of hilsa specimens were examined. Carts parked near the godown contain ice blocks in gunny bags.

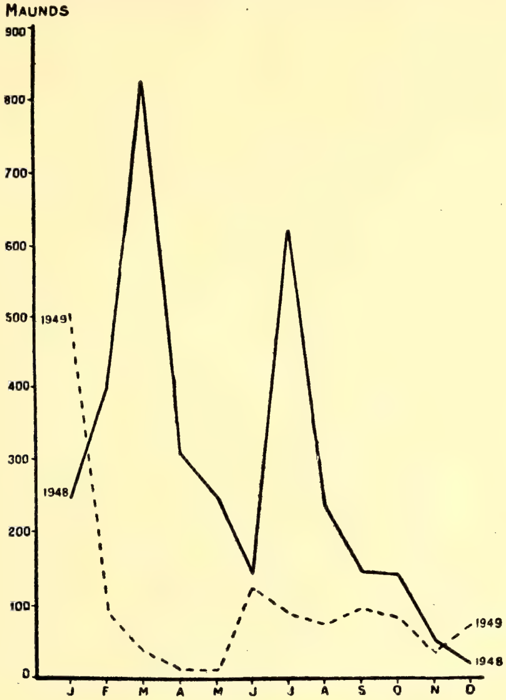


(3) A view of the interior of one of the godowns, where weighing and packing of fish are in progress.



(2) A view of the baskets in which hilsa and other fishes are packed and

catches for the Hooghly are wanting, general observations indicate, that the ascent during the floods is of considerable magnitude compared to the earlier one, while in the Chilka, it can be seen from the figures,

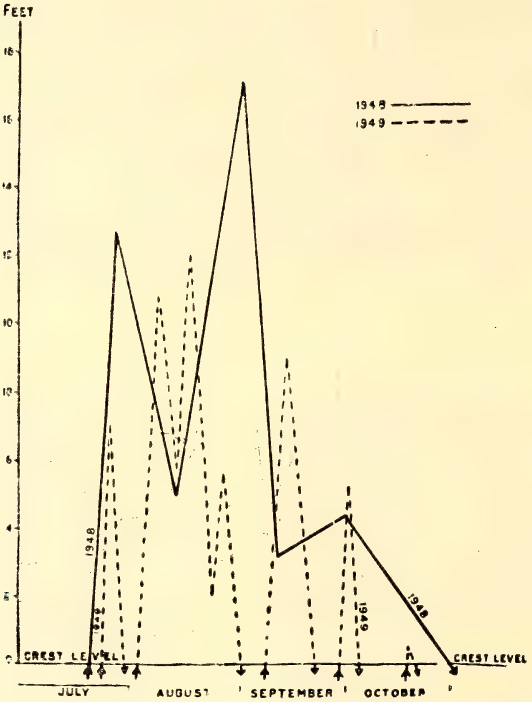


Graph I. Showing export of fresh hilsa from the Chilka Lake in the years 1948 and 1949.

that the late winter or the early spring migration is of equal, if not greater, intensity.

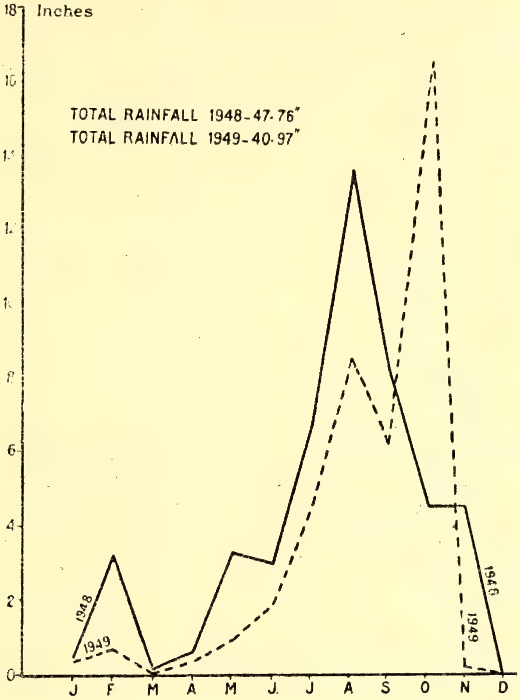
As the statistics of export show, the hilsa catches were higher in 1948 than in 1949 and enquiries made among fish merchants and fishermen reveal that catches in 1949 were distinctly lower than during the past few years, in spite of the fact that the intensity of fishing was the same. Though it is premature to attribute this decline to any particular cause, a tentative explanation may be offered. A study of the flood level over the Naraj Anicut and the rainfall in the Chilka region indicates that both the flood level and the rainfall were less in 1949 than in the previous year as is shown by the graphs II and III, and table 3. The rainfall at Puri, Gopalpur and Khurda in 1948 was 50.77, 36.89, and 55.62 inches respectively, and in 1949, 52.57, 37.15, and 33.41 inches respectively. Though the rainfall at Puri and Gopalpur, i.e. along the coast was more in 1949 than in 1948, the case was reverse at Khurda, that is to say in the hinterland where the rainfall was about two-thirds of the previous years'. Obviously it is the rainfall in the hinterland which influences the flood levels in the

Mahanadi and the subsequent flow in the Daya, which in turn causes changes in the hydrological conditions in the northern sector of the lake and thus influences the fishery. The following comparative rainfall figures also confirm the above view. The rainfall at Puri, Gopalpur and Khurda in October 1948 was 4.51, 3.83 and 5.24 inches respectively, and in October 1949, 21.69, 20.46 and 7.51 respectively, which means along the coast it was nearly three times more than at Khurda which is towards the interior, but still there was practically no rise over the crest level of the anicut. On the other hand due to high rainfall in the interior in 1948, the flow over the crest level was substantial and steady even in October 1948, though the rainfall during that month in the coastal area was less than in the corresponding month of the following year. As regards rainfall along the coast, when it is substantial, it probably creates conditions which result in congregaton of sholas in the coastal waters and this may account for the heavy catch along the Puri coast in September 1949 as stated elsewhere in this paper. It could therefore reasonably be presumed that in 1949 the flow of water from the lake into the sea, might not have been sufficient to stimulate large numbers of spawning fish to react against the current and thus ascend from the coastal waters to the lake. In this connection a similar observation recorded by Chacko and Dixithulu (1951) on the hilsa in the Godavari, that owing to the fall in the flood levels



Graph II. Showing rainfall over the Chilka region in the years 1948 and 1949. (Average of Gopalpur, Khurda and Puri.)

and the silting up of the river, the hilsa shoals did not enter the Godavari, but migrated towards the north and contributed an 'unusual sea fishery of considerable magnitude' at Kakinada (Coconada) about 50 miles away lends support to the above view, and it will be interesting to conduct investigations on the above lines for the Godavari region also. The abundance of the hilsa fishery thus seems to be dependent on a combination of factors, as in the case of the American Shad, for the migratory movements of which, according to Leach (1925), freshets, unusual turbidity of water, and the direction and the velocity of the wind, all are influential factors.



Graph III. Showing trend (i.e. continuous rise or fall) of flood levels in the Kathjuri (branch of the Mahanadi), over the crest level of the Naraj Anicut in the years 1948 and 1949.

In order to study the movements of the fish, investigations were made to find out whether the fish is a permanent inhabitant of the lake and breeds there, or whether it comes from the direction of the sea, and if so where it breeds. Elucidation of these points is likely to be helpful for formulating conservancy measures required if any, for this important fishery. There is no data available on the bionomics of the Chilka hilsa except the remark by Chaudhuri (1917) that the fish occurs throughout the year though 'it must remain doubtful if the species breeds there'. A general study of the distribution of the fish shows their comparative abundance in the northern section of the lake, where the salinity is always lower on account of the influx of water during the rains from the Daya, one of the deltaic branches of the Mahanadi River[1]. The salinity and the general hydrological conditions in the lake, which have a profound effect on fish life, however, vary from season to season.

In the case of the American Shad, *Alosa sapidisima*, it is said that its movements are largely controlled by the water temperature and that 'it is believed, that it seeks to occupy an area having a temperature of 60 or 70 degrees, and that its migrations are determined by the shifting of this area'. (Leach 1925, p. 465). The influence of temperature on the movements of the Indian shad is not known, but our observations regarding catches at Barrackpore show that the fish react to the variations in the temperature, showing very restricted migratory movements during the cold season. In February 1950, when the first wave of migration commenced, hilsa was found in the catches near Barrackpore and it was breeding also in the Hooghly. Later on there was a spell of cold wave from 12-2-50 to 16-2-50 and very few fish were reported in the catches and breeding activity was also considerably restricted. In the coastal waters, however, fluctuations in temperature should be more frequent than in the open sea, and are to a very great extent influenced by currents, winds and tides.

The actual movement of the fish from the sea into the lake and *vice versa* could not be studied, but results of local enquiries indicate that large shoals generally come from the direction of the sea along the channel of the lake by February, (January to March), when the fish is caught in appreciable numbers. In September 1949, there was an unusually heavy catch of hilsa from the sea at Puri, and this goes to indicate the presence of hilsa in the coastal waters, in the neighbourhood of the Chilka.

Regarding the seaward movement of the fish no information is available, but judging from the fishing conditions it may not be wrong to presume that intensive fishing in the shallow waters of the lake spares very few spent adults to perform the return journey and as such, movement of the stragglers if any, could not be conspicuous enough to receive attention. Prompted by the spawning urge, the breeders ascend the rivers and the spent fish drift with the flowing waters and the young also start on their gradual seaward movement. In the Hooghly the young hilsa move to the lower regions of the estuary, but the movement of the young from the Chilka to the sea is not known, as no nets similar to 'Bhin-Jals' or 'Dhara Jals' which are so common in the Hooghly and at Chandipore, are operated in the channel and its neighbourhood, and as such the young are rarely caught.

SIZE GROUPS AND SEXES

During the course of the investigations an attempt was made to determine as far as possible the size groups, the rate of growth and ratio of sexes of the fish in catches and to interpret the same statistically, and accordingly from August, 1948, onwards, samples were collected from time to time, from fish godowns at various exporting centres, for the purpose of detailed examination. The observations were continued for over a year, during which period 1762 specimens as detailed below were examined.

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[1] For general information regarding the hydrography of the lake see *Mem. Indian Mus.*, 5 (1): 5-12.

SIZES AND SEX RATIO OF THE SPECIMENS EXAMINED

MONTH	Number of Hilsa specimens examined				Combined range		Male range		Female range	
	M	F	X	T	A	B	A	B	A	B
1948—										
August	139	188	14	341	506	134	457	191	506	198
September	188	98	39	325	520	208	449	208	520	229
October	3	36	—	39	485	257	353	269	485	257
November	17	12	150	179	485	213	485	244	483	294
December	32	7	574	613	480	84	431	216	480	317
1949—										
January	—	—	25	25	434	94	—	—	—	—
February	—	—	6	6	408	307	—	—	—	—
March	28	12	7	47	383	198	383	227	300	265
April	2	2	1	5	325	206	315	250	325	308
May	12	11	10	33	470	266	382	266	470	272
June	13	11	1	25	463	230	380	230	463	305
July	20	6	—	26	384	233	376	308	384	233
August	21	25	—	46	435	221	383	221	435	231
September	10	20	—	30	418	247	408	247	418	264
November	10	11	1	22	385	246	314	246	385	251

M = Males. F = Females. X = Unidentified sex. T = Total. A = Maximum length. B = Minimum length. Length is indicated in mm.

It was found that under the existing conditions, samples conforming to the standard of truly representative and random samples, which could yield reliable information about larger bulk of the population were difficult to obtain. Besides, a number of specimens which on applying pressure gave no indication of their sex, specially in November and December 1948, but from their size appeared to be either immature or spent fish, could not be cut open to ascertain the nature of their sex. Thus the observations had to be based only on those individuals which were definitely identified by pressing and a few which could possibly be cut open and the data tabulated shows that the proportion of the males to the females in the catches is not constant as has already been observed by Southwell and Prashad (1918).

BIONOMICS

Examination of a large number of specimens showed that the gonads were in ripe condition from August to October with September-October as peak period both in 1948 and 1949. Spent hilsa were collected from November onwards in 1948 and sexually mature fish were rather rare thereafter till July-August of the next year, and a regular extended breeding season did not appear to exist as in the Hooghly hilsa (Hora and Nair 1940 a). A specimen measuring 47 mm. was obtained at Balugan towards the end of October, 1948, and young hilsa measuring from 84 mm. to 133 mm. began to appear in the catches along with other small clupeids in December 1948. Further, small specimens measuring about 110 mm. were found in the catches in April 1950. Analysing these size groups on the basis of observations made by Hora and Nair (1940) and Job (1941) on the young fish collected from the Pucca Settling Tanks of Pulta Water Works that the young fish grows roughly at an average rate of about 25 mm. a month and that ten months to a year old fish are just about a foot in length, it is possible to estimate that the breeding would have taken place by about August-September, if the fish grows at the same rate in open waters also, and thus the young specimens found in the catches in April 1950 might be the progeny of the late breeders.

Efforts were directed towards the location of the spawning grounds of the hilsa in the Chilka. Plankton collections made from the lake proper did not show any eggs or early larvae of the fish. It was felt that investigations in the northern section of the lake would yield interesting results in the location of the spawning grounds of the fish and with this object in view a systematic search was made near the mouth of the Daya, during the third week of September, 1949. On the afternoon of the 16th September, plankton collected from the river at Jagdala showed along with others, a certain type of lightly demersal eggs, and on the following morning drag net collections made from the neighbouring inundated areas of the lake showed the presence of young hilsa of about 32 mm. to 43 mm. On the next day, viz. 17-9-'49 at about 2-30 p.m. some three miles up the river, near the fishing village of Garasaguda, plankton collections from the river showed the presence of the eggs of the same type as mentioned above. They were in the early stage of development with the blastoderm as a cap of cells. The zona radiata was strikingly large and swelled up showing fine streaks on the surface and forming a double layering on preservation. The yolk was segmented as is the case in other clupeid eggs and there were several light yellow oil globules. The identity of the eggs was not clear at that time, but after working out the development of hilsa at Barrackpore, from the material collected from the Hooghly, (Jones and Menon 1950), it was possible to identify the material obtained from the Daya. At Garasaguda, along with the eggs postlarvae of hilsa (about 15 mm.) were collected, which is of significance, since it indicated the possibility of the fish breeding in the river. There was no fishing going on in the river at that time, but enquiries from the fishermen revealed that the fish goes up the river in large numbers when the latter is in floods. It could hence be said that the Chilka hilsa breeds in the lower reaches of the Daya, and probably in its associated branches also. How far up the river the fish breeds is difficult to say, but it is known to negotiate, during the heavy floods, the Naraj Anicut in the Kathjuri (from which the Daya branches off) and reach the Mahanadi. The ascent of the hilsa in the main Mahanadi river, which is spanned by the Cuttack Anicut, also takes place by about September, depending on the intensity of the floods.

During exceptionally heavy floods, hilsa is known to ascend as far as Sambalpur about 250 miles from the sea.

FOOD

The fish is essentially a plankton feeder. The oozing individuals do not appear to feed. There is no selective feeding as far as plankton is concerned. Copepods and diatoms have been found invariably to be the dominant items depending on their availability. Spent specimens have more of fine sand grains, showing more or less a sort of feeding habit at the bottom layers, while the young specimens appear to be mid-water feeders. The food of hilsa in the coastal waters has been given by Prashad, Hora and Nair (1940) and by Chacko and Ganapati (1949).

COASTAL FISHERY OF HILSA AND ITS BEARING ON CHILKA STOCKS

The hilsa fishery in the Chilka cannot be regarded as a detached and isolated one by itself as the crop is dependent on the stocks present in the adjacent coastal waters. Along the Orissa coast, as at Chandipur (Balasore) and Talpada hilsa move about in shoals and these are caught regularly from the inshore waters from the month of November. Towards the end of September 1950, large numbers of young hilsa measuring from about 38 mm. to 90 mm. were obtained by us from Chandipur and the older lot among these should be the progeny of the fish that bred towards the end of summer or the beginning of the monsoons, say May-June. Since collections from the same place, viz. Chandipur, during the previous months did not yield any stages of hilsa, it could reasonably be presumed that the fish has been breeding in some of the tidal stretches of rivers, as has been found in the Hooghly (Hora & Nair 1940 and Jones & Menon 1950 & 1951) and that the young are moving about in the coastal waters. In this connection the observations of Hora and Nair (1940 b) on the Jatka (young hilsa) fishery of East Bengal and the movements of hilsa in Sunderbans deserve special mention. The Jatka, two to five months old, feed in the estuaries and move about in shoals and though there is no definite evidence to show the actual direction of their movements, it is probable that they move from estuaries upstream and along the coastal waters. De (1910) refers to this upward movement and observes that the fish is found as high up as Goalundo in the Ganges from February to April. When exactly the first downward movement takes place is not stated. According to Howard (1938) 'the young fish after about two months' stay in the sea, add considerably to their size and weight, and towards the end of December they return to the estuaries (Sunderbans) in shoals. The fish at about this time are 7 to 9 inches long and in search of new feeding grounds'. Thus the presence of the young hilsa in the catches at Chandipur as stated above, and also at Janput along the Contai coast where specimens measuring about 50 mm. in total length were obtained in June 1949 (Jones & Menon 1951), lend support to the observations regarding the movement of the fish in coastal waters. The shoals of young hilsa thus appear to wander about along the Bengal-Balasore coasts where the hydrological conditions are similar, but whether the sea in the neighbourhood of Chilka also comes within the orbit of their wanderings is yet to be ascertained. In winter months most of the adult fish fall back from the rivers to warmer waters of the estuaries, but with the advent of the hot weather they begin to show greater activity. While the mature fish react to the current and go against it like other anadromous fishes, this does not appear to be the case with the young, which have not been observed to travel against strong currents of flooded rivers. If the salinity, temperature and flow of the currents have anything to do with the movements of the fish, it will appear that the young fish in the tidal zone and the coastal waters is subject to a diversity of ecological conditions. The comparatively low salinity (Fig. 2), favourable direction of currents (Fig. 3), availability of food etc. may be contributing towards the presence of the hilsa in the coastal waters after the monsoons, and the various factors influencing the migrations require to be studied with special reference to the physiological requirements of the fish. In this connection influence of the salinity

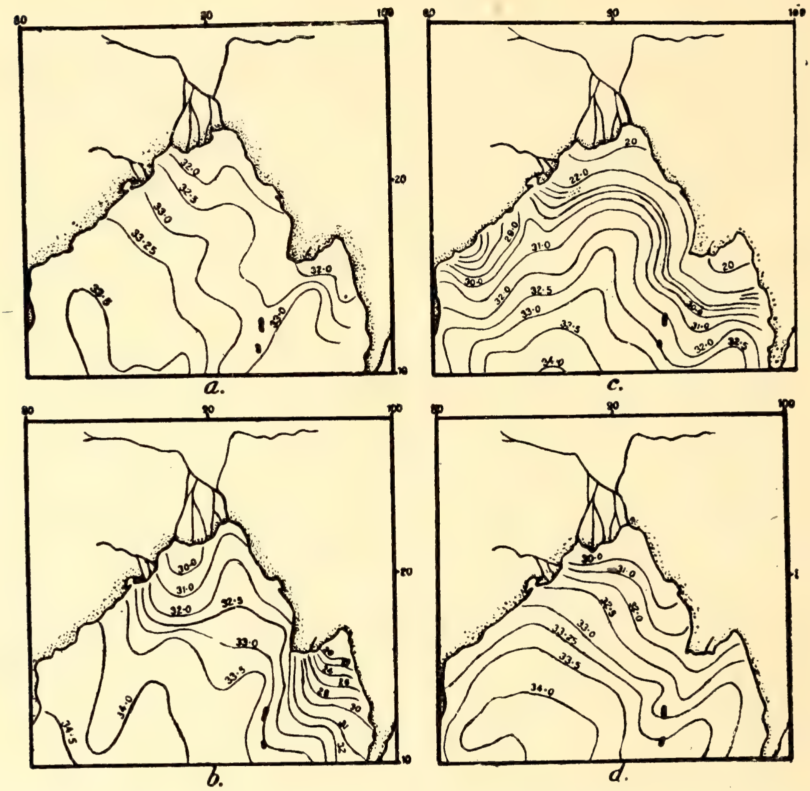

Fig. 2. Surface salinity of the Bay of Bengal (modified after Sewell): (*a*) from March to May; (*b*) from June to August; (*c*) from September to November; (*d*) from December to February.

of the coastal waters on the distribution of the Bombay-Duck, *Harpodon nehereus* (Ham.) pointed out by Hora (1934) is significant.

The currents in the sea indicate the net resultant movement of waters, inclusive of the effect if any, produced by the winds. Conditions are however different in the Chilka where similar currents are absent, tidal influence is not much specially in the main area, and the water is very shallow. The winds over the lake blow generally from the south-west from March to September and from north-east in the remaining part of the year, that is to say opposite to the general direction of the currents in the sea. The meteorological data available for the years 1948 and 1949 for Puri and Gopalpur coasts indicate, that the average monthly wind velocity at these centres did not exceed the limits of the fresh breeze on the Beaufort scale and the maximum velocity at these centres, during the period, was 36 and 44 miles per hour respectively, that is to say it never exceeded the limits of strong gale, and was only of a few hours duration. Even moderate winds disturb the surface layer considerably and as such should affect the movements of the fish in the lake in view of its shallowness.

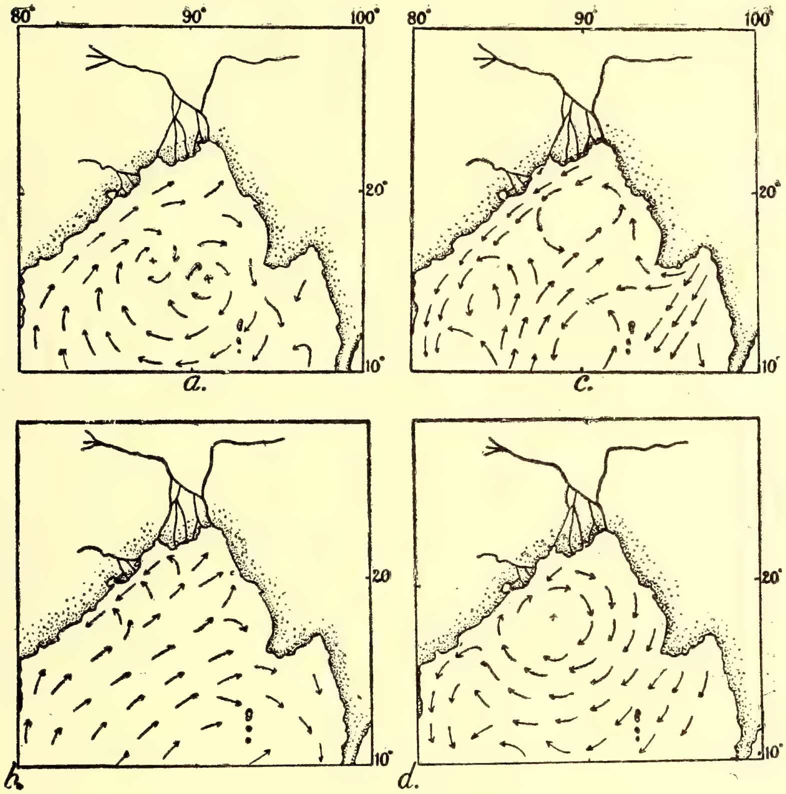

Fig. 3. Surface currents of the Bay of Bengal (modified after Sewell): (*a*) from March to May; (*b*) from June to August; (*c*) from September to November; (*d*) from December to February.

TABLE No. 1

Export of Hilsa from the Chilka in 1948 †

1948	Rambha	Kallikota	Balugan	Gangadharpur	Kuhuri *	Kaluparaghat	Total
January	1 23 8	10 24 4	28 38 —	19 12 4		193 9 13	253 27 13
February		17 10 —	1 28 8	62 3 12		326 5 4	407 7 8
March		2 8 4	17 6 12	131 39 7		679 29 4	831 3 11
April		1 28 —	36 35 4	87 13 —		189 27 8	315 23 12
May			72 7 12	26 11 —		155 21 —	253 39 12
June			72 28 12	6 21 8	24 7 8	34 9 12	137 27 8
July			67 5 8	1 21 4	108 24 4	450 37 —	628 8 —
August	— 1 12		9 33 4	19 34 12	61 30 8	153 21 12	245 2 —
September		— 2 8	68 18 8	9 1 —	11 8 8	61 11 12	150 2 4
October	— 8 —		43 — 4	7 25 4	15 37 12	78 36 4	145 27 8
November	1 4 8		18 32 8	2 39 4	10 25 8	21 25 8	55 7 4
December	— 3 —	1 29 4	13 21 8	— 35 12	— 6 12	3 9 12	19 26 —
Total ...	3 — 12	33 22 4	450 16 8	375 18 3	232 20 12	2348 4 9	3443 3 0

† Statistics collected by the Orissa Fisheries Department.
Weight is recorded in maunds, seers and chataks.

* Kuhuri centre came into existence in June 1948.

TABLE No. 2

Export of Hilsa from the Chilka in 1949 †

1949	Rambha	Kallikota	Balugan	Gangadhar-pur	Kuhuri	Kalupara-ghat	Total
January	43 36 8	91 11 4	100 28 12	195 2 8	34 1 4	47 22 4	512 22 8
February	— — 8	5 14 —	— 20 8	14 29 12	31 — —	42 3 8	93 28 4
March		— 2 4	12 28 —	5 17 12	6 35 8	16 28 4	41 31 12
April			13 24 —	— 22 8	3 16 12	1 — 12	18 24 —
May	— 8 8		— 11 —	— 1 12	12 14 4	2 9 8	15 5 —
June			9 23 12		55 17 8	61 26 12	126 28 —
July			4 5 —	— 1 8	9 34 12	76 21 8	90 22 12
August			7 20 —	— 20 12	10 31 4	54 28 —	73 20 —
September			9 5 8	4 38 —	10 3 4	73 21 12	97 28 8
October			9 — 12	1 14 —	11 10 —	60 2 8	81 27 4
November	17 4 12	— 10 8	11 27 8	— 4 12	— 38 4	2 4 12	32 10 8
December	— 2 —	1 21 4	33 5 —	4 14 —		31 33 4	70 35 8
Total	61 12 4	98 19 4	211 39 12	227 7 4	186 2 12	470 2 12	1255 4 —

† Statistics collected by the Orissa Fisheries Department.
Weight is recorded in maunds, seers and chataks.

TABLE No. 3

Rainfall in inches at Puri, Gopalpur and Khurda

Year	Place	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
1948	Puri ...	0·19	3·76	—	0·01	2·71	5·03	10·13	12·79	8·66	4·51	2·98	—	50·77
	Gopalpur ...	0·04	3·51	0·11	0·27	3·44	0·59	5·05	9·71	5·58	3·83	4·76	—	36·89
	Khurda ...	0·92	2·24	0·02	1·34	3·65	3·25	4·97	18·05	10·07	5·24	5·87	—	55·62
	Average ...	0·38	3·17	0·04	0·54	3·27	2·96	6·72	13·52	8·10	4·53	4·54	—	47·76
1949	Puri ...	0·22	1·95	—	0·61	0·65	2·11	7·91	8·47	8·45	21·69	0·51	—	52·57
	Gopalpur ...	—	—	—	0·46	0·30	1·96	3·21	4·53	6·23	20·46	—	—	37·15
	Khurda ...	0·64	—	—	0·24	1·85	1·42	2·50	12·40	6·85	7·51	—	—	33·41
	Average ...	0·29	0·65	—	0·44	0·93	1·83	4·54	8·47	7·18	16·55	0·17	—	41·04

SUGGESTIONS FOR THE CONSERVATION OF THE FISHERY

Although the protection of the breeders and the young as suggested by Hora (1941) and Devanesan (1942) may be the best course for the conservation of the hilsa fishery, the conditions prevalent in the lake, present many difficulties for the successful achievement of this object. The vastness of the lake, coupled with its shallowness and intensive fishing which is in vogue, make it very difficult to restrict fishing for any period or to observe any close season, more so since the fishing is not done for the sake of catching hilsa alone, as is the case in rivers, at the time of the ascent of the fish. Added to this, the close-meshed 'Patua Jals' which are used for catching anchovies and white bait, which do not grow to a large size, entrap young hilsa as well, during the course of the fishing. However, the possibility of restricting fishing for some limited period in the narrow belt of water, near the mouths of the Daya and the Makra cannot be entirely ruled out, so that the breeders coming up to the river mouths from the lake may get a chance for access into one of these. The fish coming from the sea through the channel first get scattered in the vast expanse of the shallow waters of the lake, but later on are led by the current in the direction of the rivers, at their points of discharge. Restriction on fishing in the lake from the mouth of the Makra to the mouth of the Daya in a narrow belt of 2 to 3 miles is not likely to affect materially the fishing industry, but would afford opportunity for the protection of the breeders and the young and the consequent conservation of this important fishery. The success of this measure, in a rather out of trying and its long range effect worth studying.

As similar hydrological conditions exist along the Bengal-Orissa coasts, the hilsa studies in this region may be co-ordinated so as to enable simultaneous detailed studies of the biology of the fish with special reference to the movements of the crop. While in rivers the fish is known to ascend for hundreds of miles, the range of its movements in the coastal waters remains to be studied. The migratory movements and the raciation studies of the fish are also likely to indicate whether or not the fish moves to the parent waters for breeding. The nature of shoals and their size, and the seasons when their movements take place, are also points which require to be studied in detail if the hilsa resources are to be properly utilised. The studies of the movements of the fish and the factors influencing migration would require a team of workers to conduct marking experiments, length and weight studies, etc., and to collect hydrological, meteorological and other relevant data over a wide range.

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NOTES ON BUTTERFLIES FROM NEPAL

BY

LT.-COL. F. M. BAILEY, C.I.E.

PART II

(*Continued from p. 87 of this volume*)

ERYCINIDAE

198. **Libythea lepita lepita** M.

Evans 1.2.

Very common in the Valley, March, April and May. Often at damp soil. A pair *in copula* 1-4-38.

199. **Libythea myrrha sanguinalis** Fruh.

Evans 1.3.

Uncommon. A few in the Valley in August. One specimen in October and one in November.

200. **Zemeros flegyas indicus** Fruh.

Evans 2.

Common in the Valley all the year except December, January and February. Also many brought in by collectors from the north.

201. **Dodona durga** Koll.

Evans 3.1.

A single specimen at Chitlang, 1,500 ft. on 20-7-35.

202. **Dodona dipoea** Hew.

Evans 3.2.

In the Valley and surrounding hills from March to October. Especially plentiful in May and September. A single specimen was taken on 15-11-37. Both subspecies *D. d. nostia* Fruh. and *D. dipoea* Hew. appeared to be together, but there is very little superficial difference between them.

203. **Dodona eugenes** Bates.

Evans 3.3.

Very common in the Valley and the surrounding hills; most plentiful in April, in early May, and again in September. A female was seen depositing dull pink globular eggs on the woody stalk of the food plant on 6-8-35.

As in the case of the last, both subspecies *E. e. eugenes* and *E. e. venox* Fruh. are found together, but the subspecies are almost indistinguishable.

204. **Dodona egeon** Db.

Evans 3.4.

Common in the Valley especially so on the surrounding hills from March to November. Most plentiful in May.

205. **Dodona ouida ouida** M.

Evans 3.5.

Common in the Valley and especially in the surrounding hills March to November.

206. **Dodona adonira adonira** Hew.

Evans 3.6.

At Godaveri in the Valley, May and June and again in October usually on damp stones.

207. **Abisara fylla** Db.

Evans 4.1.

A few in the Valley, April to November.

208. **Abisara neophron neophronoides** Fruh.

Evans 4.2.

A single specimen at Nagarkot, 6,000 ft. 7-6-37.

209. **Abisara echerius suffusa** M.

Evans 4.5.

Not found in the Valley. Common at Devighat 1,500 ft. and the Terai in winter.

LYCAENIDAE

210. **Poritia hewitsoni hewitsoni** M.

Evans 2.5.

Not in the Valley. Bhimpedi, below the Valley, in October; Devighat 1,500 ft. 3-11-36.; eastern Terai 28-2-38.

211. **Spalgis epius epius** Wd.

Evans 8.

Two specimens at low elevations; Amlekganj 1,000 ft. 15-11-35; Tribeni, Terai 5-12-35.

212. **Castalius rosimon rosimon** F.

Evans 11.1.

Not in the Valley but only at lower elevations. Devighat 1,500 ft. October; the Terai in winter.

213. **Castalius caleta decidia** Hew.

Evans 11.2.

At Devighat 1,500 ft. and in the Terai in winter. This is an extension of habitat westwards in the Himalayas.

214. **Tarucus dharta** B—B. (W)[1]

Evans 12.2.

A single specimen at Amlekganj, 1,500 ft. 3-6-36.

215. **Tarucus callinara** But.

Evans 12.4.

A single specimen at Devighat 2,000 ft. 31-10-36.

216. **Syntarucus plinius** F.

Evans 13.

A single specimen at Katmandu 4,500 ft. 12-9-35.

217. **Everes argiades indiea** Ev.

Evans 18.2.

Common at Katmandu and in the Valley. A few on the surrounding hills, April to October.

218. **Everes dipora** M.

Evans 18.4.

Not in the Valley but on the surrounding hills. Nagarkot 6,000 ft. 28-7-37; Chandragiri 6,000 ft. 10-4-37; Chitlang 4,000 ft. 23-2-37. A few brought in by collectors from west Nepal.

219. **Everes parrhasius parrhasius** F.

Evans 18.5.

One in the Valley, Katmandu 13-10-35; one at Kakni, above the Valley 7,000 ft. 25-8-37; two at Devighat 1,500 ft. 31-3-35 and 29-10-35 and one brought in from Galchi, west Nepal 5-11-36.

220. **Megisba malaya sikkima** M.

Evans 20.

One specimen at Godavari in the Valley 5,000 ft. 31-7-35; one at Nagarkot 5,500 ft. 3-8-35; several in the Terai in winter.

221. **Lycaenopsis puspa gisca** Fruh.

Evans 21.2.

Common in the Valley and on the surrounding hills. A few in March and April, very many in July and August, fewer in September and October. A pair *in copula* at Nagarkot 7,000 ft. 31-8-35.

222. **Lycaenopsis marginata** DeN.

Evans 21.11.

Common in the Valley, the surrounding hills and in the Terai. A few in April, many May to August. Pairs *in copula* at Nagarkot 6,000 ft. 29-7-35, and at Kakni 6,500 ft. 28-8-37.

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[1] (W) or (E) indicate extensions of known habitat from Sikkim westward or from Kumaon eastward, respectively.

223. **Lycaenopsis transpecta** M. (W)

Evans 21.12.

A few in the Valley and the surrounding hills in May and June. Devighat 1,500 ft. 31-10-35.

224. **Lycaenopsis vardhana** M. (E)

Evans 21.13.

Five specimens at Sheopani above the Valley, 8,000 ft. on 14-9-37. The specimens are rather brighter blue than specimens from Simla.

225. **Lycaenopsis albocoerulea** M.

Evans 21.15.

Common in the Valley and on the surrounding hills from the end of March to the end of October.

226. **Lycaenopsis lavendularis placida** DeN. (W)

Evans 21.19.

A single specimen at Godaveri in the Valley 5,000 ft. 20-6-36.

227. **Lycaenopsis cardia dilecta** M.

Evans 21.20.

Common in the Valley and surrounding hills end of March to early November. Most plentiful May to July. Often at damp sand and cowdung.

228. **Lycaenopsis hugelii hugelii** M. (E)

Evans 21.22.

Not found in the Valley, but two specimens from the surrounding hills. Nagarkot 6,000 ft. 4-7-36 and Kakni 7,500 ft. 15-9-37.

Very many brought from north-west Nepal between the end of May and mid-September. A pair *in copula* 1-6-36.

Several specimens of *L. hugelii oreana* Swin. were taken at Godaveri 5,000 ft. May, June and October ; some also on Sheopuri Hill 8,000 ft. 14-9-37.

229. **Lycaenopsis ladonides gigas** Hemming. (E)

Evans 21.23.

West Nepal 1936.

230. **Lycaenopsis argiolus sikkima** M. (W)

Evans 21.24.

A few in the hills above the Valley up to 7,000 ft. March to September. A single specimen on 28-12-36 at 2,000 ft. at Bhimpedi below the Valley.

231. **Lycaenopsis jynteana** DeN. (W)

Evans 21.25.

Only two specimens Katmandu 4,500 ft. 2-5-36 ; Nagarkot 7,000 ft. 24-6-36.

232. **Polyommatus astrarche** Berg. (E)

Evans 22.10.

A few brought from north-west Nepal, Yakpa 27-8-36, Pensa 13-9-36.

233. **Polyommatus galathea galathea** Blanch. (E)

Evans 22.19.

Several brought in from north-west Nepal, July 1936.

234. **Polyommatus eros ariana** M.

Evans 22.27.

Many brought in from north-west Nepal. Simkot, June to September 1936; Yakpa 27-8-36. Pensa 13-7-36 and 13-9-36. The subspecies is doubtful. I have never found any form of *eros* in Sikkim, Chumbi Valley or Bhutan, though *eros stoliczkana* Fd. is common in Tibet north of the Tang La and at Gyantse, Lhasa and in the Tsangpo Valley. I have caught it as far east as Sangachö Dzong, E Long. approx. 97° 10′.

235. **Chilades laius laius** Cr.

Evans 23.

Tribeni, Terai, 13-12-35.

236. **Zizeeria trochilus trochilus** Freyer.

Evans 24.1.

Devighat, 1,500 ft. 29-10-35 ; Katmandu, 4,500 ft., 9-10-36 and 29-10-36.

237. **Zizeeria maha maha** Koll.

Evans 24.3.

Very common at Katmandu March to October. Also common at Nagarkot and Kakni 6,000 ft. July to October. Pairs *in copula* at Katmandu 4-3-35 and at Nagarkot 26-7-35. Common in the Terai in December.

238. **Zizeeria lysimon** Hub.

Evans 24.4.

Terai, December and March. Not found in the Valley.

239. **Zizeeria otis otis** F.

Evans 24.6.

A single specimen at Katmandu, 4,500 ft. 10-10-35. Common in the Terai, October to March, and at Devighat at the end of October.

240. **Euchrysops cnejus** F.

Evans 25.1.

Common in the Terai, scarce in the hills. Katmandu 4,500 ft. 4-6-35. Nagarkot 6,500 ft. 6-9-35. A pair *in copula* at Devighat 2,000 ft. 25-10-35.

241. **Euchrysops contracta contracta** But.

Evans 25.2.

A single specimen in the Terai 26-3-36.

242. **Euchrysops pandava pandava** Hors.

Evans 25.3.

Many of the wet season form in the Legation garden in early August 1937. Most were on Michaelmas daisies.

243. **Lycaenesthes emolus emolus** God.

Evans 26.1.

A single specimen in the Valley 24-4-37, and two at Nagarkot, 5,500 ft. in July. Others at lower levels and in the Terai in winter. An extension westwards in the Himalayas.

244. **Lycaenesthes lycaenina lycambes** Hew. (W)

Evans 26.2.

Not found in the Valley, but a few at lower levels. Nowakot, 3,000 ft. 17-10-35; Devighat, 1,500 ft. 30-10-35; Bhimpedi, 2,000 ft. 21-7-36.

245. **Catachrysops strabo** F.

Evans 27.1.

In the Valley and up to 7,000 ft. at Nagarkot, March, July, September and October; also in the Terai in winter.

246. **Catachrysops lithargyria** M. (W)

Evans 27.2.

A single female specimen at Katmandu 4,500 ft. 18-3-37. Evans gives ' Assam to Burma '. This butterfly has never been taken in Sikkim so this is a considerable extension of habitat westwards. The specimen was identified at the British Museum.

247. **Lampides boeticus** L.

Evans 28.

Very common everywhere. In March females were depositing eggs on the buds of wistaria and lupin in the Legation garden. The buds were so covered in eggs that from a few feet away they appeared quite grey.

248. **Jamides bochus bochus** Cr.

Evans 29.1.

A few of both sexes in the Valley and up to 6,000 ft. on the surrounding hills in June and November; also in the Terai in winter.

249. **Jamides celeno celeno** Cr.

Evans 29.5.

Very common in the Valley; W.S.F. July to October and D.S.F. October to December. Specimens in October and November are very variable. Specimens taken in the Terai in December are of an extremely dry form. A single specimen of the D.S.F. was taken in the Valley on 20-3-33.

250. **Jamides alecto eurysaces** Fruh.

Evans 29.9.

A few in the Valley in October; very common in the Terai in December and January. This is an extension westwards in the Himalayas.

251. **Nacaduba pactolus continentalis** Fruh. (W)

Evans 32.2.

A single specimen at Katmandu 4-10-37.

252. **Nacaduba kurava euplea** Fruh. (W)

Evans 32.8.

Three female specimens Katmandu 4,500 ft. 26-9-35 and Nagarkot 7,000 ft. in July.

253. **Nacaduba nora nora** Fd.

Evans 32.15.

Several specimens from Nagarkot 6,000 ft. 7-6-37. Also several in the Terai in winter. None were actually seen in the Valley.

254. **Nacaduba dubiosa indica** Evans.

Evans 32.16.

None were taken in the Valley but a few at Nagarkot 6,000 ft. 7-6-37; also in the Terai in winter. Specimens were identified at the British Museum.

255. **Lycaena pavana** Koll. (E)

Evans 34.1.

A few brought in by collectors from north-west Nepal in May and June 1936.

256. **Lycaena phloeas indicus** Ev. (W)

Evans 34.2.

Very many brought in by collectors from north-west Nepal June to August 1936.

257. **Heliophorus sena** Koll. (E)

Evans 35.1.

A few brought in by collectors from west Nepal, June and October 1936.

258. **Heliophorus epicles indicus** Fruh.

Evans 35.2.

Common in the Valley, May to November, and also at lower elevations.

259. **Heliophorus bakeri** Ev. (E)

Evans 35.4.

Several brought in by collectors from west Nepal in May and June 1936.

260. **Heliophorus oda** Hew. (E)

Evans 35.5.

A single specimen brought in from Melcham, west Nepal, 12-6-36.

261. **Heliophorus androcles androcles** Hew. (W)

Evans 35.8.

Many brought in by collectors from west and north Nepal and the Tibetan border, May and June. One from Patechaur, north Nepal, 11-11-37. A single male on Sheopuri Hill, above the Valley, 8,000 ft. 14-9-37.

262. **Heliophorus tamu tamu** Koll

Evans 35.9.

Many in the Valley, mostly at damp soil, May to September. Kakni, 7,000 ft. 24-8-37. Many on Sheopuri Hill, above the Valley, 8,000 ft. 14-9-37 and many brought in from the north.

263. **Euaspa milionia** Hew. (E)

Evans 40.

Very common in the woods in the Nepal Valley, April to July; specimens taken after May were very worn.

264. **Thecla icana** M. (E)

Evans 41.1.

Two male specimens at Chandragiri, above the Valley 6,000 ft., 14-6-36. These have more orange than usual at the tornus unh. I have also taken this in Bhutan and in southern Tibet.

265. **Thecla birupa** M. (E)

Evans 41.12.

Several on the hills surrounding the Valley, 5,000 to 7,000 ft., May, June and July.

266. **Thecla syla assamica** Tyt. (W)

Evans 41.14.

A single female specimen from Jalbiri, north central Nepal, 3-8-37. The specimen was identified at the British Museum.

267. **Chaetoprocta odata** Hew. (E)

Evans 42.

Many at Godaveri in the Nepal Valley in May, flying round, and at dusk roosting on the upper sides of leaves of walnut trees; also many brought in from north-west Nepal in June 1936.

268. **Curetis bulis** Db. & Hew.

Evans 44.4.

A few in the Valley, April, May and June.

269. **Curetis acuta dentata** M.

Evans 44.6.

Tribeni, in the Terai, 1,000 ft 26-1-36; Bhimpedi, 1,000 ft. October. A female in eastern Terai, 3-3-26. One at Katmandu, 4,300 ft. in the Valley, 17-10-36.

270. **Iraota timoleon timoleon** Stoll.

Evans 45.1.

Several in the Valley and up to 6,000 ft. on the surrounding hills, May to September.

271. **Amblypodia oenea** Hew. (W)

Evans 49.27.

A single specimen at Katmandu, 4,500 ft., 4-10-37.

272. **Amblypodia alemon** DeN.

Evans 49.34.

One specimen in the Valley, 5,000 ft. 22-5-37. Common in the Terai in winter.

273. **Amblypodia centaurus pirithous** M.

Evans 49.36.

Very common at Devighat October to May; common also in the Terai in winter. A few in the Valley.

274. **Amblypodia amantes amantes** Hew.

Evans 49.39.

Only in the Terai in winter.

275. **Amblypodia singla** DeN. (W)

Evans 49.40.

A few in the Valley up to 6,000 ft., March to August.

276. **Amblypodia bazalus** Hew. (W)

Evans 49.41.

A few in the Valley and up to 6,500 ft. on the surrounding hills.

277. **Amblypodia eumolphus eumolphus** Cr.

Evans 49.42.

A few in the Valley, July and August.

278. **Amblypodia dodonea** M. (E)

Evans 49.50.

A single specimen from Yarsa in west Nepal, 5-8-35.

279. **Amblypodia rama rama** Koll.

Evans 49.51.

Very common in the Valley and on the surrounding hills, March to October. A few at lower elevations and in the Terai in winter.

280. **Amblypodia paramuta** DeN. (W)

Evans 49.53.

In the Valley and up to 7,000 ft. on the surrounding hills; common at Nagarkot July to October.

281. **Amblypodia ganesa ganesa** M. (E)

Evans 49.65.

Three specimens in the hills above the Valley; Nagarkot, 7,000 ft. 2-7-37; Thankot, 6,000 ft. 17-7-37; Kakni, 7,000 ft. 27-8-37. This subspecies was checked at the British Museum.

282. **Amblypodia paraganesa paraganesa** DeN.

Evans 49.66.

In the Valley and on the surrounding hills up to 7,000 ft.; common July to September. A single specimen as late as 9-11-35. at Nagarkot, 5,000 ft.

283. **Amblypodia chinensis** Fd. (W)

Evans 49.78.

A few in July and August on the hills surrounding the Valley, between 5,000 and 7,000 ft.

284. **Amblypodia areste areste** Hew. (W)

Evans 49.79.

Four specimens on the hills above the Valley. Nagarkot, 6,000 ft. 1-7-37 and 9-9-37; Kakni, 7,000 ft. 26-8-37 and 15-9-37.

285. **Surendra quercetorum quercetorum** M.

Evans 50.1.

A single specimen at Devighat 1,500 ft. 27-10-35.

286. **Loxura atymnus atymnus** Cr.

Evans 53.

A single specimen in the Valley, 4,500 ft. 7-8-37. Common at lower elevations in August and September

287. **Spindasis nipalicus nipalicus** M.

Evans 57.9.

One specimen at Katmandu, 4,500 ft. 10-6-35. Several at Nagarkot, 7,000 ft. in May. A few in the Terai and at lower elevations, March to October.

288. **Spindasis syama peguanus** M.

Evans 57.12.

Bhimpedi, early October 1936; Devighat 1,500 ft. 1-4-35 and three specimens on 25-10-35. This is an extension of habitat westwards in the Himalayas.

289. **Spindasis lohita himalayanus** M. (W)

Evans 57.13.

Common at Katmandu especially on Michaelmas daisies in the Legation garden in August and September. One brought in from the north, Chauntara, 13-9-37.

290. **Pratapa ctesia** Hew.

Evans 59.2.

Common above the Valley between 5,000 and 7,000 feet, where it flies round tree tops; May to August.

291. **Pratapa blanka argentia** Aurivill. (W)

Evans 59.4.

A single female at Devighat, 2,000 ft., 25-10-35.

292. **Pratapa deva lila** M.

Evans 59.5.

A few on the hills above the Valley, 5,000 to 7,000 feet, in July. A single specimen at 5,000 ft., 15-10-36. Flies around tree tops.

293. **Pratapa icetas icetas** Hew. (E)

Evans 59.6.

Common on the hills above the Valley, 5,000 to 7,000 feet, July to September. Flies around isolated tree tops.

294. **Pratapa cleobis** God.

Evans 59.8.

Common on the hills above the Valley, July and August and a few in June, September and October; 5,000 to 7,000 feet. A few were taken in the Valley between April and November.

295. **Pratapa bhotea** M. (W)

Evans 59.9.

A single specimen at Kakni, 7,500 ft., 15-9-37.

296. **Tajuria jangala ravata** M. (W)

Evans 60.1.

One female specimen at Nagarkot, 5,500 ft., 8-8-35, and a male brought in from Dendrowati, 18-5-35.

297. **Tajuria yajna istroidea** DeN. (W)

Evans 60.4.

Two specimens which appear to be nearest to *istroidea*, Nagarkot, ♀ 7,000 ft., early August; Katmandu, 4,500 ft., 2-9-37.

298. **Tajuria illurgis** Hew.

Evans 60.20.

Katmandu 4,500 ft., April and August; Nagarkot, 6,000 and 7,000 feet, July and August. Two specimens brought in from the north, Kodari, 17-5-37, and Gumtang, 20-5-37.

299. **Tajuria illurgoides** DeN.

Evans 60.21.

Nagarkot, 7,000 ft., 5-6-37. Two from Kang Lang, north Nepal, 19-5-37.

300. **Tajuria luculentus nela** Swin. (W)

Evans 60.22.

A single female specimen at Thankot, above the Valley, 6,000 ft., 26-4-36. This single specimen is abnormal and may be new and has been given to the British Museum. It is a considerable extension of habitat westwards. Evans gives Assam as the habitat in India.

301. **Tajuria maculata** Hew. (W)

Evans 60.23.

Two specimens, Sundarijal in the Valley, 5,500 ft., 4-7-30; Nagarkot, 7-9-37.

302. **Charana jalindra indra** M.

Evans 61.1.

Several in and around the Valley, May to October. This is an extension of habitat in the Himalayas westwards.

303. **Horaga onyx onyx** M.

Evans 77.1.

A single specimen, Katmandu, 4,300 ft., 9-10-35.

304. **Catapoecilma elegans major** Fruh.

Evans 78.1.

Devighat, 1,500 ft., 31-3-35, 1-4-35; Nagarkot, 5,000 ft., 17-6-35.

305. **Chliaria othona** Hew.

Evans 79.1.

A single specimen at Bhimpedi, below the Valley, 2,000 ft., 27-9-36.

306. **Chliaria kina cachara** M.

Evans 79.2.

Common on damp stones in the Valley and up to 6,000 ft. on the hills, March to October. Two specimens may be *C. kina kina* Hew. These are extensions of habitat east (*C. k. kina*) and west (*C. k. cachara*).

307. **Hypolycaena erylus himavantus** Fruh. (W)

Evans 80.3.

Valley April to July, some at lower elevations in October.

308. **Zeltus etolus** F. (W)

Evans 81.

Two specimens below the Valley, Nawakot, 3,000 ft., 17-10-35; Devighat, 2,000 ft., 1-11-35.

309. **Deudoryx epijarbas ancus** Fruh. (W)

Evans 83.1.

Common in the Legation garden at Katmandu in July, August and September. Frequently at Michaelmas daisies. A female bred from a larva in an apple emerged 2-7-37. The subspecies was checked at the British Museum.

310. **Virachola perse perse** Hew.

Evans 84.2.

Two specimens in the Valley, 1-9-35; a female specimen at Devighat, 1,500 ft., 3-11-36.

311. **Rapala refulgens** DeN.

Evans 85.5.

A few taken in the Valley between April and September.

312. **Rapala tara** DeN.

Evans 85.9.

A few at Godaveri in Valley, 5,000 ft. in May and October, but at no other time or place.

313. **Rapala varuna orseis** Hew. (W)

Evans 85.11.

Katmandu, 4,500 ft., 4-5-35, 11-10-35, 3-9-37. A specimen at Tribeni in the Terai, 3-12-35.

314. **Rapala schistacea** M.

Evans 85.12.

Not uncommon in the Valley and up to 6,000 ft. at Nagarkot; April to September.

315. **Rapala scintilla** DeN. (W)

Evans 85.13.

On the hills surrounding the Valley. Two specimens, Nagarkot, 7,000 ft. end of October 1936; Thankot, 6,000 ft., 26-4-36.

316. **Rapala pheritimus petosiris** Hew. (W)

Evans 85.14.

A few in the Valley, between June and October; Devighat, 1,500 ft., 25-10-35; a specimen brought in from the north Dendrawati, 18-5-35.

317. **Rapala melampus** Cr.

Evans 85.16.

A single specimen at Katmandu 4-6-35. This is an extension of habitat eastwards in the Himalayas.

318. **Rapala nissa nissa** Kol.

Evans 85.19.

Very common in the Valley. The first appearance is in March when a great many are seen on flowering shrubs. A favourite bush is *Ligustrum nepalense* Wall. The numbers gradually diminish until October. Up to 7,000 ft. at Nagarkot, June, July, and August.

319. **Sinthusa chandrana** M.

Evans 86.2.

A single specimen at Katmandu, 23-3-37.

320. **Sinthusa nasaka pallidior** Fruh. (E)

Evans 86.3.

A few in the Valley, March to September.

HESPERIIDAE

321. **Hasora chromus chromus** Cr.
Evans 1.16. Cat. A.3.13.
Katmandu, 24-4-37, 23-6-37.

322. **Bibasis vasutana** M.
Evans 2.15. Cat. A.1.9.
Godaveri, Valley 5,000 ft., 20-10-36.

323. **Choaspes xanthopogon** Koll.
Evans 4.4. Cat. A.5.4.
Valley, March, May, August and October.

324. **Celaenorrhinus ratna tytleri** Evans. (W)
Evans 11.9. Cat. B.6.9.
One specimen at Katmandu 20-3-36.

Several on surrounding hills up to 7,000 ft. Like its congeners it inhabits dense forest where it settles on the underside of leaves.

325. **Celaenorrhinus munda** M.
Evans I1.17. Cat.B.6.19.
Kodari, north Nepal, 27-5-37.

326. **Celaenorrhinus dhanada dhanada** M.
Evans 11.29. Cat.b.6.27.
One specimen, Katmandu, 2-9-37.

327. **Lobocla liliana ignatius** Plötz. (E)
Evans 12.2. Cat.B.4.1.

Many in the Valley and on the surrounding hills where it flies round tree tops in bright sunlight in May and June. A specimen from Kodari, north Nepal, 22-8-37.

328. **Seseria dohertyi dohertyi** Watson.
Evans 13.7. Cat.C.8.2.
Six specimens in the Valley, April to July.

329. **Tagiades gana athos** Plötz.
Evans 14.3. C.12.2.
A single specimen in the eastern Terai 8-3-26.

330. **Tagiades menaka menaka** M.
Evans 14.9. Cat.C.12.9.
Common in the Valley from April to October.

331. **Tagiades litigosa litigosa** Mosch.
Evans 14.10. Cat.C.12.8.

Common in the Valley, March to May ; some at lower elevations in October.

332. **Coladenia dan fatih** Koll.

Evans 20.1. Cat.C.5.1.

Common in the Valley, May to August. Many brought in by collectors from west Nepal.

333. **Sarangesa dasahara dasahara** M.

Evans 21.3. Cat.C.6.2.

Devighat, 1,500 ft. and lower elevations below the Valley, May, July and October.

334. **Darpa hanria** M. (W)

Evans 22.1. Cat. C.3.1.

Several at Godaveri in the Valley 5,000 ft., April and May. All were drinking on wet stone.

335. **Ctenoptilum vasava vasava** M. (W)

Evans 24.1. Cat.C.16.1.

A single specimen at Katmandu, 4,500 ft., 22-4-35.

336. **Spiala galba** F.

Evans 28.2. Cat.D.4.2.

Common in the Terai in winter. A few in the Valley and up to 5,000 ft., June and October.

337. **Aeromachus stigmata stigmata** M.

Evans 43.4. Cat.G.6.4.

A single specimen Kakni, 7,000 ft., 15-8-35.

338. **Aeromachus jhora jhora** Dn. (W)

Evans 43.8. Cat.G.6.6.

Two specimens at Thankot above the Valley, 7,000 ft., 17-7-37.

339. **Pedesta masuriensis** DeN.

Evans 44.1. Cat.G.9.1.

Several in the Valley and surrounding hills up to 7,000 ft. April, to August; also brought in by collectors from Kodari, north Nepal, 22-5-37.

340. **Iambrix salsala salsala** M.

Evans 46.2. Cat.I.1.1.

A few at Devighat below the Valley, 1,500 ft. in March and April.

341. **Ancistroides nigrita diocles** M. (W)

Evans 55.1. Cat.I.5.1.

Bhimpedi, 1,000 ft., early October.

342. **Udaspes folus** Cr.

Evans 57.1. Cat.I.7.1.

Common in the Valley and surrounding hills, April to August.

343. **Notocrypta feisthamelii alysos** M.

Evans 58.5. Cat.I.6-6.

Common in the Valley and surrounding hills usually in dense forest, March to September.

344. **Notocrypta curvifascia curvifascia** Fd.

Evans 58.6. Cat.I.6.5.

Common in the Valley, April to August. Especially plentiful in April.

345. **Erionota torus** Evans

Evans 60.1. Cat.J.14.1.

A single specimen at Khatmandu, 6-4-35.

346. **Matapa aria** M.

Evans 64.1. Cat. J.17.1.

A single specimen at Bhimpedi, 1,500 ft., 15-11-35.

347. **Sovia grahami** Evans.

Evans 83.4. Cat.G.8.1.

Two specimens brought by collectors from Kashiganj, north Nepal, 7-8-35.

348. **Thoressa aina** DeN.

Evans 83.9. Cat.G. 11.17.

One specimen from the interior of Nepal and one from Thankot above the Valley 5,000 ft., 17-7-37.

349. **Thoressa gupta gupta** DeN.

Evans 83.12. Cat.G.11.15.

A few in the Valley at 5,000 ft., in May.

350. **Halpe kumara** M. (W)

Evans 83.28 Cat. G. 12–5.

One specimen from the Valley 20-6-36. Several brought in from north Nepal in May and June ; Kodari 15-5-37 and 22-5-37.

351. **Taractrocera danna** M.

Evans 88.1. Cat. L. 1-1.

Common in the Valley and up to 6,000 ft. on the surrounding hills; flies along sunny roadsides.

352. **Taractrocera maevius sagara** M.

Evans 88.2 Cat. L. 1.2.

Several in the Valley, March, June and August.

353. **Potanthus dara** Koll. (E)

Evans 90.8. Cat. L. 5.13.

One specimen at Nawakot below the Valley 2,500 ft., 2-4-35.

354. **Potanthus pseudomaesa clio** Evans.

Evans 90.10. Cat. L. 5.8.

Two specimens from the Valley. Khatmandu, 4,500 ft., 3-10-35, Godaveri, 5,000 ft., 8-10-36.

355. **Potanthus confucius dushta** Fruh.

Evans 90.12. Cat. L. 5.16.

Two specimens from the Terai. Tribeni 3-2-36; Morang, east Terai, 28-2-26.

356. **Telicota ancilla bambusae** M.

Evans 91.2. Cat. L. 7-9.

Raxaul, 1,000 ft., 7-3-38. Devighat, 1,500 ft., 25-10-35.

357. **Ochlodes brahma** M.

Evans 93.8. Cat. K. 3.11.

On hills surrounding the Valley, April and May. Some brought in from the interior, May and June.

358. **Baoris farri farri** M.

Evans 97.1. Cat. M. 6.2.

A single specimen in the western Terai, 3-2-26.

359. **Caltoris cahira austeni** M. (W)

Evans 97.9. Cat. M. 7.5.

Two specimens from the Valley. Khatmandu, 4,500 ft., 16-10-37, Godaveri, 5,000 ft., 20-10-36.

360. **Caltoris tulsi tulsi** DeN. (W)

Evans 97.13. Cat. M. 7.12.

Khatmandu, 4,500 ft., 16-10-37, 27-10-37.

361. **Polytremis eltola eltola** Hew.

Evans 97.21. Cat. M. 5.11.1.

Common in the Valley, April to October, and on the surrounding hills at 7,000 ft. in August.

362. **Pelopidas sinensis** Mab.

Evans 97.30. Cat. M. 4.1.

Common in the Valley and up to 7,000 ft. on the surrounding hills, June to August, a few in April.

363. **Pelopidas mathias mathias** F.

Evans 97.31. Cat. M. 4-5.

Several in the Valley, September and October; a few brought in from Yarsa, north Nepal, 5-8-35; in the Terai at lower elevations December and January.

364. **Parnara guttatus mangala** M.

Evans 97.32. Cat. M. 2.1.

Very common in the Valley and on the surrounding hills, July to October; a few in March and May. A pair *in copula* at Khatmandu, 26-9-37.

365. **Borbo bevani** M.

Evans 97.34. Cat. M. 3.3.

Common everywhere March to October; a pair *in copula* at Nagarkot, 6,000 ft., 9-9-35.

Since compiling this list I have seen a fine collection of Nepal butterflies which has been presented to the British Museum by Colonel D. G. Lowndes who was a member of Tilman's expedition to Nepal in 1950. This includes an interesting *Parnassius delphius* and several *Coleas* which are quite different to any I obtained. In fact, it was clear that my collectors did not venture high enough to get such things.

HABITS OF THE COMMON MEMBRACID ('TREE-HOPPER') —*OTINOTUS ONERATUS* WALK.

(*HOMOPTERA*: *RHYNCHOTA*)[1]

BY

Basanta Kumar Behura, M.Sc. (Cal.), Ph.D. (Edin.), F.R.E.S.

Department of Zoology, Ravenshaw College, Cuttack.

SYNOPSIS

The habits of the membracid *Otinotus oneratus* Walk., are studied. A list of host-plants in Calcutta and Orissa is given. It infests a large variety of plants belonging to different families among which are included a number of cultivated plants of economic importance e.g. *Mangifera indica, Tamarindus indica, Cajanus indicus. Cinnamomum tamala, Citrus aurantium* and *Zizyphus jujuba.* The nymphs and adults of the membracid species are attended by the common black ant *Camponotus compressus* Fabr., both on poisonous and non-poisonous plants alike.

INTRODUCTION

Distant's (1908, 1916) admirable works on the taxonomy and distribution of Indian membracids are of great value, but little is known about their bionomics and host-plants.

Observations on the common membracid *Otinotus oneratus* Walk., were made by me during the months of October and November, 1945 as well as at other times during 1946-47 in a village called Sudhakanthy, in the Balikuda sub-division of the district of Cuttack, Orissa. This species also occurs in Calcutta and its habits were studied by me in Calcutta too, in the garden of the University College of Science, 35 Ballygunge Circular road during the period July, 1945 to September, 1946. Although Distant (1908, 1916) states a number of discontinuous places showing its wide distribution throughout India, *O. oneratus* has been recorded from Orissa from only two places viz:—Rambha and Satpara in the Ganjam district.[2]

Funkhouser (1917) has given an admirable account of the ecology of the New World membracids. Since accounts of the habits of Indian membracids are greatly wanting and practically nothing is known about the habits of any species of the genus *Otinotus*, I have endeavoured to describe in some detail my field observations. The village Sudhakanthy was selected by me for the study, as the various host-plants belonging to different families occurred in plenty in this locality. However, some difficulty was experienced in the identification of the host-plants in the absence of a suitable work on the flora of this region. Most of the plants were kindly identified by Mr. C. M. Bastia of the Department of Botany, Ravenshaw College,

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[1] The paper was presented to the Indian Science Congress, Bangalore, 1951 and an abstract appeared in the *Proc.* 38 *Ind. Sc. Cong.* (3): 213-214.

[2] Distant's (1916) Janjam district is apparently a mis-print for Ganjam district.

Cuttack, to whom I am very grateful. I also record my sincere thanks to Mr. D. Mukerji of the Department of Zoology, University College of Science, Calcutta University, for his kind help during the preparation of the manuscript.

MEASUREMENTS

In the species *O. oneratus* the males are usually smaller than the females. Specimens collected on the host-plant *Lawsonia alba* L., in Calcutta on 21-7-1945 measured as follows: Males 5 mm. to 5.8 mm., average 5.3 mm.; and females 5.6 mm. to 6.2 mm., average 6 mm.

HOST-PLANTS

Apart from a mere statement by Buckton (1903) that *Oxyrachis lignicola* which was later placed as a synonym under *O. oneratus* by Distant (1908), laid eggs on 'the bark of a leguminous shrub' obtained from Raniseram, South India, practically nothing is known about the host-plants of this species.

A plant should be indicated as a host-plant only when the pest actually feeds and breeds on it. In this paper, the term 'host-plant' has been used in its broadest sense that mating, feeding and young stages of these insects are available on the plants. Whether eggs were laid on the plants cannot be definitely stated in the majority of the cases as they might have escaped my attention. An examination of the host-plants indicated that *O. oneratus* feeds on a large variety of plants belonging to various families.

The following is the list of plants usually somewhat heavily infested in the Sudhakanthy locality:

	SCIENTIFIC NAME OF THE PLANT	FAMILY	LOCAL POPULAR NAME CURRENT IN ORIYA
1.	*Mangifera indica* Linn ...	Anacardiaceae	Amba (mango)
2.	*Anona reticulata* Linn ...	Anonaceae	—
3.	(?) *Daemia extensa* Br. ...	Asclepiadaceae	—
4.	*Flacourtia ramontchi* L'H. ...	Bixaceae	—
5.	*Tamarindus indica* Linn.	Caesalpiniaceae	Kaiyan (Tamarind)
6.	*Cinnamomum tamala* Fr. Nees ...	Lauraceae	Teja-patra
7.	*Gossypium herbaceum* F. B. I. ...	Malvaceae	Kapa (Cotton)
8.	*Michelia champaca* Linn.	Magnoliaceae	Champa
9.	*Cajanus indicus* Spreng.	Papilionaceae	Harada
10.	*Erythrina indica* Lamk.	Papilionaceae	Paladhua
11.	*Citrus aurantium* Linn...	Rutaceae	Silata kamala (Orange)
12.	*Zizyphus jujuba* Lamk...	Rhamnaceae	Barakoli
13.	*Zizyphus oenoplia* Mill...	Rhamnaceae	Bhuin Barakoli, Kantai koli
14.	*Datura fastuosa* Linn. ...	Solanaceae	Kala dhutura
15.	Tips of stilt roots of *Ficus bengalensis* Linn.	Urticaceae	Bara (Banyan tree)

(Although *O. oneratus* is commonly found on the stilt roots of the banyan tree, I doubt if it is a true host-plant of the membracid species. I have not found eggs and nymphs of this species on this tree.)

In Calcutta *O. oneratus* was observed on the following plants:

	SCIENTIFIC NAME OF THE PLANT	FAMILY	LOCAL POPULAR NAME CURRENT IN BENGALI
1.	*Cajanus indicus* Sp. ...	Papilionaceae	Arhar
2.	*Lawsonia alba* Linn. ...	Lythraceae	—
3.	*Morus indica* L. ...	Moraceae	Tut
4.	*Zyzyphus jujuba* Lamk. ...	Rhamnaceae	Kul
5.	*Acacia moniliformis* Griseb. ...	Leguminosae	—

HABITS

O. oneratus like other membracids are sun-loving insects and are often found on plants growing in the open fields. They live in droves grouped at the axils of the branches and on the mid-ribs of leaves on the adaxial side. Three or five form a group. Usually they form such a dense group that the insects touch one another. The crowd stays for hours at a place. In the majority of the cases, the adults rest with their heads pointing toward the base of the branch or point downward if they are on the trunk. While resting on hanging stilt roots of *Ficus bengalensis* the head directly points downward. This characteristic attitude can be explained as they simulate the thorns of the host-plants by their three pronotal spines with head pointing down. The nymphs lie attached to crevices of the bark by flattening of bodies or rest close to the axil of a leaf or crotch of a twig. In most cases the coloration of the nymphs as well as that of adults is such that they are not easily seen in such situations.

They are generally most active during the warm parts of the day; feeding, mating and flight taking place from 10 o'clock in the morning to 4 o'clock in the afternoon. The species is decidedly gregarious in habit. The insects remain in one spot for a long time deeply planting their proboscis in plant tissues, drawing sap, and do not move to tap fresh sources. While engaged in feeding they are found generally attended by ants. I have never come across any membracid being attacked or killed by other animals.

Pairing occurs with the caudal extremities meeting and the heads facing in opposite directions. The pair on being disturbed fall to the ground, but they do not separate. The only movement perceptible is when the female drags forward the male (in copula) behind it.

Eggs are commonly deposited under bark of young twigs. In Calcutta and Cuttack, I noticed the eggs especially on the shoots of

Cajanus indicus. The eggs are deposited in small groups running in two parallel lines cut in the twigs of trees and shrubs.

If disturbed the insect usually circles round the axis of the twig or stem, but does not take to flight unless seriously disturbed. The insect fails to notice the approach of any foreign object if the movement of the latter be slow. It may even be touched with the finger if one is cautious and the hand is moved slowly; the sharp quick motion of an approaching object is readily detected by the insect which immediately takes to flight through the air.

The usual method of progression is walking on the host-plant. The walking motion is deliberately slow. If gently poked it goes round the stem with an awkward gait and flying is its last resort. Although the term 'tree hopper' is applied to the family, this species was never seen hopping about from stem to stem or leaf to leaf. Of the three methods of locomotion—flying, walking and jumping—the last is certainly the least seen. In taking off it leaps through the air and in the last lap of the jump the wings are spread out. The flight, however, is seldom sustained for a long distance. The nymphs of course are unable to fly, and in no case has a nymph been seen to jump or take a leap. It crawls.

ATTENDANCE BY ANTS

The remarks of Wheeler (1910) that 'The relations of the ants to the tree-hoppers (Membracidae, Cercopidae) are but little known, as these insects are abundant only in warm countries' (p. 350) unfortunately are still applicable. In some of the accounts from India bearing on the problem, one misses the reference to the membracid or that of the ant.

It may be recalled that Belt (1874) was the first scientist to record the attendance of ants on a species of membracid larvae, though Sharp (1899) doubted it. Green (1910) put forth his observations in support of Belt. He stated that the larvae of various species of *Centrotus* were assiduously attended by ants. However, that the larvae and adults of membracids are attended by ants is now a well established fact (Imms, 1948).

In all the host-plants without a single exception I find that the common black ant *Camponotus compressus* Fabr., attends the nymphs and adults of the membracid *O. oneratus*. The ants stroke the membracids with their antennae, whereupon these ant 'cattle' give off from the anal tube a liquid that issues in bubbles in considerable quantity. The liquid is colourless and transparent. The anal tube of the membracid is capable of great evagination specially in the nymphs, in which it is long and cylindrical and this is usually raised upward. This honey dew of the anal tube is eagerly licked by the ants. The adults as well as the nymphs are 'milked' by the ants in the same way. It is worth pointing out that the adults do not excrete the liquid in such quantity as the nymphs. In general, the mutual relationship between *O. oneratus* and *C. compressus* exists in the same way as that found between aphids and ants. The ants seek the membracid assiduously. In many cases the hiding places of the membracid nymphs are detected by following the marching column of the ants. The ants do not drive these 'cattle', as in the case of certain aphids in ant-home perhaps because the membracids find natural shelter under the crevices of bark or are distasteful to carry in the mouth.

The advantage to the membracid evidently accrues from the protection they get from the ants, which do not hesitate to bite viciously the fingers of the collector who seeks to remove nymphs or adults from the plant. As soon as the finger is brought near the membracids the ants rush forth to bite so as to drive away the intruder.

Ayyar (1935) in his admirable study of the life-history of *C. compressus* stated that '*Camponotus*, which ordinarily infests a considerable variety of plants, seems to avoid a few poisonous plants, even though these may be situated in the vicinity of its nest'. Among such plants he includes *Datura fastuosa* and further states that even when poisonous plants harbour sap-sucking Homoptera these ants do not care to live in association with them, and the plants are completely free from ants.

My own observations are quite contrary to the above. I have found large numbers of *C. compressus* attending colonies of *O. oneratus* on poisonous plants like *Datura fastuosa* and *Daemia extensa*. This undoubtedly shows that *C. compressus* follows membracids even when they occur on poisonous plants.

ECONOMIC IMPORTANCE

So far as feeding is concerned there is little evidence that membracids directly cause any injury to the host-plants. The quantity of sap consumed by the insects is negligible and the wounds made by the proboscis of their beaks are neither large enough to destroy tissue nor extensive enough to offer an opportunity for other types of infection. Careful examination of trees in the field revealed no indication of any possible injury from the feeding of membracids.

The oviposition in plants can be more destructive, but even this appears to cause little injury to the host-plants though minor lacerations of outer bark are noticeable.

The agricultural importance of the membracids lies in the injury they cause, in an indirect manner, to a variety of cultivated crops, trees and shrubs by their symbiotic association with the ant *C. compressus*. The ants by coaxing the membracids to yield more drops of sweet excretion make these insects draw sap heavily and thereby indirectly cause the loss of sap.

Where the infestation of *O. oneratus* is very heavy, as for instance on *Tamarindus indica*, especially when the tree is in fruit, the ants crowd in plenty. Further, by the growth of *Datura* plants and such other shrubs near about the mud houses, the membracids thrive and encourage the ants to make their nests nearby and the ant population by their sheer number becomes obnoxious.

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CRITICAL NOTES ON THE IDENTITY AND NOMENCLATURE OF SOME BOMBAY PLANTS

BY

H. SANTAPAU, S. J.

(*With two plates*)

The subject of these notes has been under consideration for a long time; the materials for this paper were collected mainly during my long stay in Kew Herbarium and library.

During the last few years it has been my lot to hear some very disparaging remarks on the question of name changes of Indian plants; some authors have even begun to demand that a list of *Nomina Specifica Conservanda* be adopted similar to that of *Nomina Generica Conservanda* and thus settle the question once and for all. I have discussed this point elsewhere, and so I shall not dwell on the same point any further. Suffice it to say at this stage that the changes suggested in the following paragraphs are necessitated by the more accurate study of the identity of our Indian plants; it is not merely a question of names, it is a question of the actual identity of the plants that go under very well known names in most of our Floras.

1. Terminalia tomentosa and T. crenulata.

In the district around Bombay, scattered through dense forests or on more or less bare plateaus and slopes, there is a common tree that is popularly known under the name of *Ain*. Cooke in his Flora gives the following synonyms for the tree:

Terminalia tomentosa Wight & Arn.
  T. glabra var. *tomentosa* Dalz. & Gibs.
  T. crenulata W. & A.
  T. coriacea W. & A.
  Pentaptera tomentosa Roxb.

As it is plain from this list of synonyms, Cooke has mixed up at least three plants, that Clarke in Fl. Brit. Ind. 2: 447-448 recognized as three distinct varieties of the same species.

Gamble in his Flora of Madras Presidency, pp. 462-463, 1919, has, following Wight and Arnott, separated this complex group into three different species. The reasons for this step are stated by Gamble in Kew Bull. 1920:51 thus: 'While travelling on Forest duty in various parts of South India I could not help being struck by the inadequacy of the arguments by which the well-marked species of *Terminalia, T. crenulata, T. tomentosa* and *T. coriacea,* admitted by Wight and Arnott, were joined together into one species, *T. tomentosa,* in the "Flora of British India". I have, therefore, gone back to the arrangement of Wight and Arnott.'

The following table, based on Gamble's key in his Flora of Madras, pp. 462-463, gives the specific differences of these three plants:

	coriacea	*tomentosa*	*crenulata*
Leaves underside.	yellowish-brown velvety	villous	glabrous or nearly so
Leaves ...	coriaceous	coriaceous	membranous/chartaceous
	obtuse/emarginate	obtuse/emargin./subacute	obtuse/acute
	unequal cordate	rounded/cordate	narrowed
Twigs and infloresc.	yellowish-brown velvety	villous	glabrous
Panicles ...	...	dense	lax
Glands ...	sessile	stalked	stalked
	at base of midrib	near base of midrib	someway up midrib
Fruit ...	yellowish-brown velvety	glabrous	glabrous

Examining our Bombay plants in accordance with this key, it is plain that only *T. crenulata* is common in these parts of India. Cooke's description is based on mixed material of the three species; for this reason I give herewith the complete description and synonymy of our plant.

Terminalia crenulata Roth, Nov. Pl. Sp. 380, 1821; Wight & Arn., Prodr. 314.

Pentaptera crenulata Roxb., Hort. Beng. 34, 1814 & Fl. Ind. 2: 438, 1832.

T. tomentosa var. *crenulata* Clarke in FBI. 2: 448, 1878.

T. tomentosa Cooke, Fl. Pres. Bombay 1: 479, 1903; Talbot, For. Fl. 2: 18, t. 297, ambo pro parte.

An erect deciduous tree 2-25 m. high, small when growing in open rocky plateaus and slopes, very large in dense forest. Young branches and inflorescence often badly attacked by insects and covered with unsightly galls. Young parts more or less yellowish-brown pubescent, older parts glabrous or nearly so. Leaves opposite or subopposite, fairly thick, 5-18 × 3-7 cms., ovate or elliptic-oblong, often obovate, glabrous or nearly so, with 1-2 glands, (which occasionally are absent); the glands are stalked and placed some way up along the midrib, occasionally they are on the side nerves; leaf apex rounded or obtuse, subacute or acute; base narrowed, rounded or subcordate, sometimes distinctly unequal-sided; margins entire, shallowly crenate or subserrate; nerves parallel, arcuate, quite clear; petioles about 1 cm. long, glabrous when old. Flowers hermaphrodite, in axillary or terminal, lax, glabrous or nearly glabrous panicles; flowers strongly and sweetly honey-scented. Calyx glabrous outside, broadly campanulate, teeth broadly triangular, hairy within; bracts glabrous or nearly so. Disc with long fulvous hairs. The whole flower at first is greenish, then pale yellowish, finally turning brown.

Fruit up to 5 cms. or more long, up to 5 cms. diam. including the 5 broad wings; nerves on wings very numerous, faint, running horizontally from the axis to the edges. The ripe fruits remain on the parent tree for a long time, occasionally even when the flowers of the next flowering season are on.

A very common tree in Bombay State; when in full foliage and flower it is a good sight, and many insects, especially bees, seem to frequent it for honey. This is the only species of the complex *coriacea-tomentosa-crenaldta* that is truly common in Bombay; I have seen no specimens of the other two species.

2. The genus Bridelia in Bombay State.

Under the popular name of *Asana* there is another complex group of trees consisting of at least 2, probably 3 different species of the genus *Bridelia*; Cooke in his Flora covers these several species under the name of *B. retusa*.

The following key to the Bombay species of *Bridelia* has been based on that of Gehrmann in his monograph in Engler, Bot. Jahrb. 41, Beibl. 95, pp. 26-28, 1908.

KEY TO THE BOMBAY SPECIES OF BRIDELIA

Leaves ovate or elliptic or oblong:
Female flowers pubescent inside or outside; climbers:
Flowers pubescent outside, glabrous inside ... *scandens.*
Flowers glabrous outside, pubescent inside ... *stipularis.*
Female flowers glabrous; erect trees:
Flowers gathered in clusters on leafless branches. *retusa.*
Flowers in clusters in leaf axils:
Leaves rounded at the base, attenuated at the apex, acute, glabrous when old ... *squamosa.*
Leaves ovate-elliptic, rounded at the apex, sometimes emarginate, tomentose at least beneath when old ... *roxburghiana.*
Leaves cuneate, mostly abruptly and shortly acuminate; erect shrubs ... *hamiltoniana.*

Bridelia scandens (Roxb.) Willd., Sp. Pl. 4: 979, 1805 pro parte; Gehrmann, loc. cit. 29; Jablonszki, Pfreich. 65: 55.

B. stipularis Muell.-Arg. in DC., Prodr. 15 (2): 499, 1866, pro min. parte.

Cluytia scandens Roxb., Pl. Cor. 2: 39, t. 173, 1798.

B. stipularis Cooke, Fl. Pres. Bombay 2: 573, pro parte.

As it is plain from the key and from the synonymy, the modern trend is to consider *B. scandens* Willd. as distinct from *B. stipularis* Blume; in this separation I have followed Gehrmann, Jablonszki and Gamble; the latter in his Flora of Madras keeps the two plants separate.

Gamble describes this plant thus: 'A large climbing shrub with thorny stems and branches, the flowering spikes often long and distichous with small leaves.' (p. 1281). Jablonszki loc. cit. mentions this plant for Bombay: 'Concan (Stocks, Law, etc. . . .)', whilst the following species is not mentioned as occurring in our parts of India. Examination of the specimens in Blatter Herbarium, collected by Blatter himself, Hallberg and McCann, Sedgwick, Acland and my own collection, shows that it is this species and not *B. stipularis* that is common in Bombay. I have come to this conclusion judging my materials by Gehrmann's key; the same conclusion is reached using Gamble's more detailed key given on p. 1280 of his Flora of Madras.

North Kanara, Dharwar, *Sedgwick* 1831! Anmod, *Sedgwick* 3379! Yellapur, *Nana* 5815! Arbail Ghat, *Sedgwick* 5822! Jog, *Hallberg* & *McCann* 35041! Londa, *Santapau* 10882! 10883! Deccan, Kolhapur, *Acland* 1094!

Bridelia stipularis (Linn.) Blume, Bijdr. 2: 597, 1825; Muell.-Arg. in DC., Prodr. 15 (2): 499, pro parte; Gehrmann & Jablonszki ll. cc.; Gamble, Fl. Madr. 1281; Cooke, loc. cit. pro parte.
B. scandens Willd., loc. cit. pro min. parte.
Cluytia stipularis Linn., Mant. 127, 1767.

'A large climbing shrub, with fulvous-tomentose branches, often thorny when young, the leaves on flowering shoots small but often wanting' (Gamble, p. 1281). Cooke's description is based on mixed material, which for the most part seems to belong to the preceding species. In Blatter Herbarium there are several specimens labelled '*B. stipularis*' but as stated above, they all belong to the preceding species.

Bridelia retusa (Linn.) Spreng., Syst. Veg. 3: 48, 1826; Gehrmann 30; Jablonszki 69; Gamble, 1279; Cooke, 572 pro parte.
B. spinosa Willd., Sp. Pl. 4 (2): 979, 1805; Graham 184.
Cluytia retusa Linn., Sp. Pl. 1042, 1753.

As stated in the key given above, this species is typified by the clusters of flowers on long terminal or axillary paniculate spikes. It is a rare plant in Bombay; the only specimens in Blatter Herbarium are the following: W. of Dharwar *Sedgwick* 2852! Dapoli, *Acland* 1093, 1122!

In Blatt. Herb. there are several sheets, some of them of my own collection, that seem to be intermediate between this and the following species; flowers or fruits are in clusters in the leaf-axils, but at the same time they are also in terminal leafless spikes on one and the same specimen. Of this intermediate category are the following numbers: Concan, Campoli, 28336! Salsette Island, *Nana* 1589 (2)! 1589 (3)! *Santapau* 975! 976! (see plate I, fig. 1).

Bridelia squamosa (Lam.) Gehrmann, in Engler, Bot Jahrb. 41, Beibl. 95: 30, 1908 sensu lato; Jablonszki 70.
Cluytia squamosa Lam., Encycl. 5 (2): 54, 1790.
B. retusa Cooke, Fl. Bombay Pres. 2: 572, pro parte, non Spreng.

This is the common and typical *Asana* of Bombay, with flowers clustered in the axils of leaves, and the leaves being attenuated at

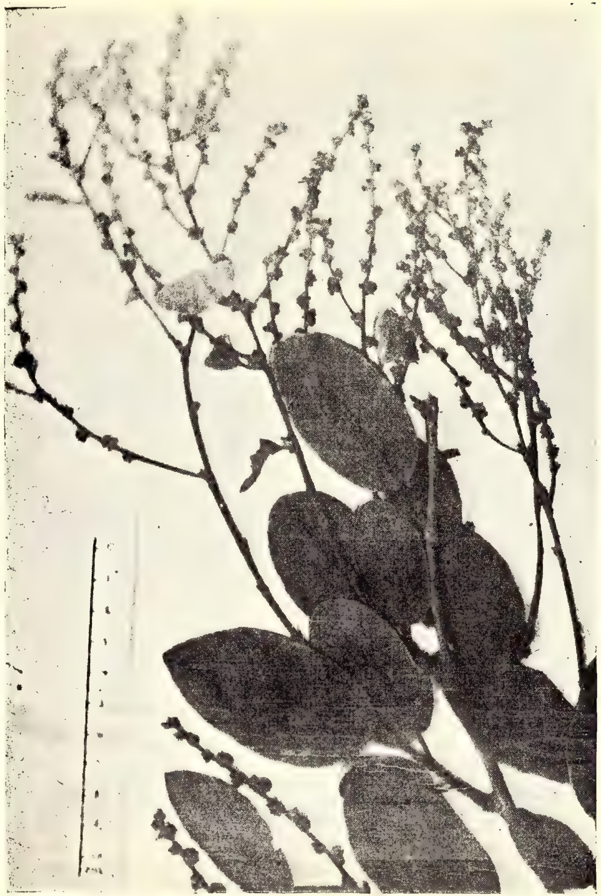

Fig. 1. *Bridelia retusa* Spr.

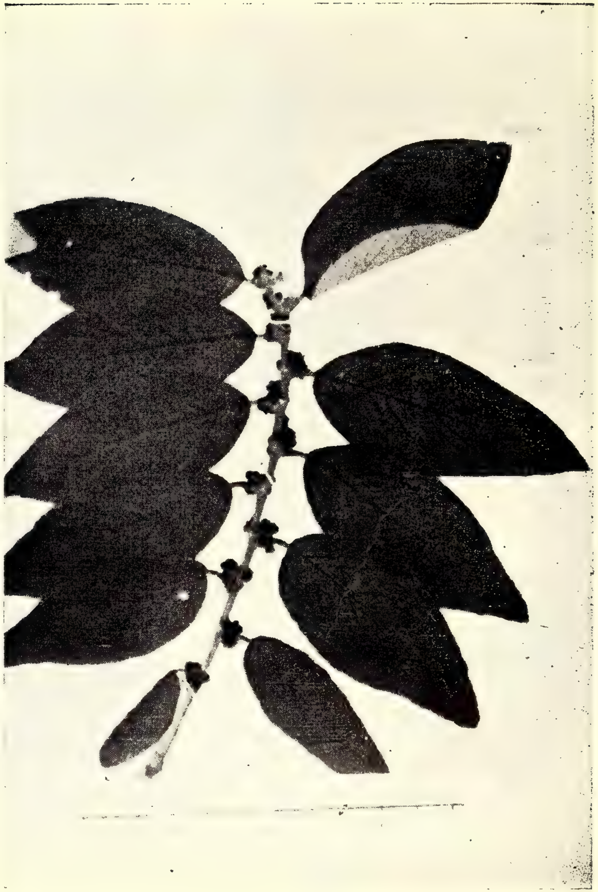

Fig. 2. *Bridelia squamosa* Gehrm.

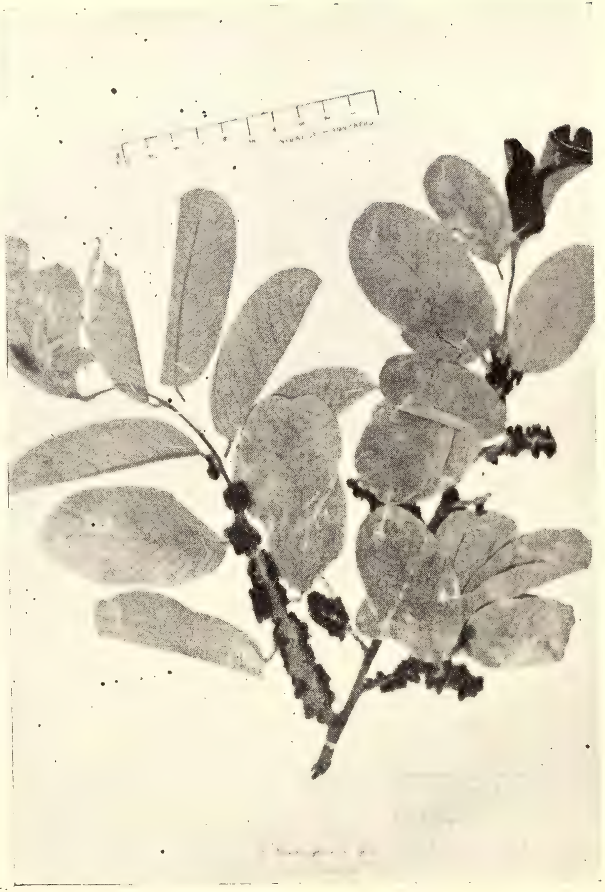

Fig. 3. *Bridelia roxburghiana* Gehrm.

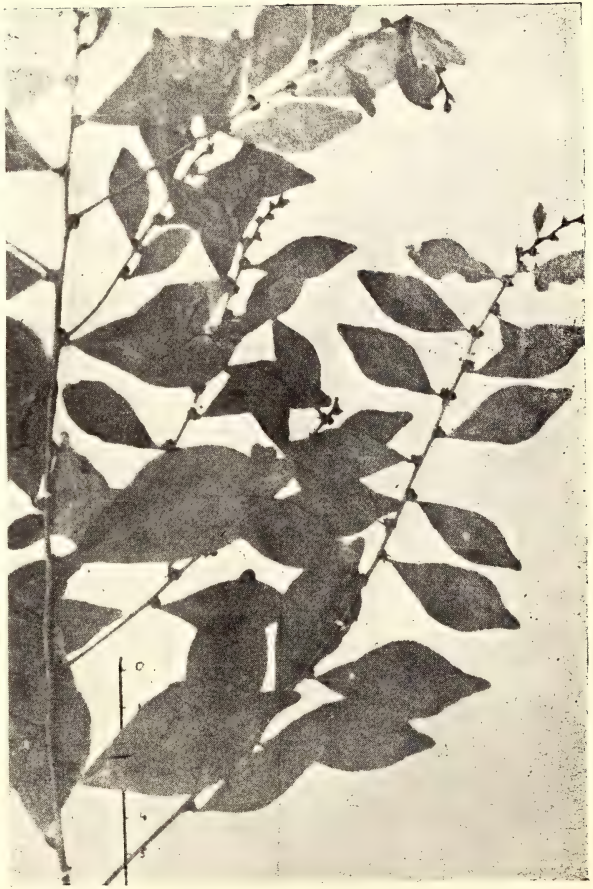

Fig. 4. *Bridelia hamiltoniana* Wall.

the apex and glabrous. Jablonszki describes this species thus: 'Shrubs or small trees about 7 metres high; branchlets somewhat thick, the younger ones greyish- or rufous-tomentose or puberulous. Stipules large, ovate or triangular or narrowed, 5-9 mm. long; leaf-blade rigidly coriaceous, 7-14 cms. long, 2-5.5 cms. broad, lanceolate or ovate-lanceolate, acute or acuminate at the apex, rounded at the base, more or less shining above, dull or subglaucous beneath, somewhat hairy to more or less glabrous, densely papillose; nerves 14-20. Flowers clustered, pubescent or nearly so outside, axillary. Drupe globose, 8-11 mm. diam. The rest as in *B. retusa*.'

For the occurrence of this tree in Bombay, Jablonszki cites the following sheets: Lanavla, *Meebold* 4696, 4901; Matheran, *Meebold* 4902; Castle Rock, *Meebold* 9820; Khandala *Meebold* 8946. In Khandala I have collected this plant on numerous occasions, but my sheets are not mentioned here, as they are listed in my Flora of Khandala. Other specimens from Blatter Herbarium are: Castle Rock, *Ahmed Khan* 4177! Near Kolhapur, *Acland* 1092! 1107! Salsette Island, *Santapau* 68.75! Purandhar, *Kulp* 8434! Mahableshwar, *Santapau*! Simhagadh Fort, *Santapau*! (see plate I, fig. 2).

Bridelia roxburghiana (Muell.-Arg.) Gehrmann, loc. cit. 30; Jablonszki 70, f. 12; Gamble, 1279
B. retusa var. *roxburghiana* Muell.-Arg. in DC., Prodr. 15 (2): 493, 1866; Fl. Brit. Ind. 5: 268.

'Branches thick, glabrous, the younger ones rufous-puberulous. Stipules caducous; leaf blade ovate, subcordate at base, rounded at apex, 5-9 cms. long, 2.5-4.5 cms. broad, strongly coriaceous, pale yellowish green above, dull and more or less softly rufous-villous beneath, densely papillose. Clusters axillary; flowers puberulous outside. Drupe globose, 7-8 mm. diam. The rest as in the preceding species' (i.e. in *B. squamosa*). (Jablonszki loc. cit.).

Gamble in his description (p. 1279) adds that the leaves are obtuse or emarginate at the apex. Cooke does not mention this plant for Bombay. On the other hand Sedgwick on a herbarium sheet of his collection remarks that this plant is 'v. common in forests' about Dharwar (see plate II, fig. 3).

Karwar, *T. R. Bell* 7806! Dharwar Dist., *Sedgwick* 2348! Devicop, Dharwar Dist., *Sedgwick* 5921! Ratnagiri, on the Ghats, *Santapau* 68.1!

Bridelia hamiltoniana Wall., Cat. 7882, 1847 (nomen nudum); Muell.-Arg. in Linnaea 34: 77, 1865-66 & in DC., Prodr. 15 (2): 500, 1866; Fl. Brit. Ind. 5: 271; Gehrmann, 34; Jablonszki 62; Cooke, 2: 573.

A shrubby plant with very typical rhomboid or diamond-shaped leaves. To the localities mentioned by Cooke, add the following: Trombay, *Meebold* 16511; Elephanta Island, *Acland* 1095! Khandala, *Santapau* 1343! 4665! Mumbra, *Santapau* 8153! 12061! 12062! Mulgaon, Salsette Island, *Santapau* 68.29! 68.57! Kaneri Caves, *Santapau* 7055! (see plate II, fig. 4).

3. Atylosia or Cantharospermum?

In his Supplement to the Botany of Bihar and Orissa (1950) Dr. H. Mooney states (p. 52): '*Cantharospermum scarabaeoides* (Linn.) Baill. . . . is the correct name for *Atylosia scarabaeoides* Benth. . . .' and mentions a number of species of the same genus that have been shifted to *Cantharospermum* as the only correct name for that group of plants.

The question of these two names has been very lucidly discussed by Sprague in Kew Bull. 1927: 134-135, from whom I quote the following paragraph:

'The two competing names were published in the same work and at the same date by Wight and Arnott (Prodr. Fl. Pen. Ind. Or. 255, 257: 1834). *Cantharospermum* being on p. 255 and *Atylosia* on p. 257. Taubert apparently chose *Cantharospermum* because of this "priority of place". Merrill . . . remarked that "the generic name *Cantharospermum* W. & A. has only page preference over *Atylosia* W. & A., and the latter is by far the more commonly used one. The fact that *Atylosia* was not included in the list of *nomina conservanda* of the Vienna Botanical Congress is an excellent illustration of the inconsistency of that list." This appears to have been written under a misapprehension. "Priority of place" is not recognised in the International Rules. Under Art.46, the first author who united *Atylosia* and *Cantharospermum* was at liberty to choose either of the names, and his choice cannot be modified by subsequent authors. Bentham . . . appears to have been the first to unite the two genera, and he adopted the name *Atylosia*. Hence *Atylosia* is the correct name under the Rules (unless it can be proved that the two genera were united previously by an author who chose *Cantharospermum*), and it is therefore unnecessary to place it on the list of *nomina conservanda*.'

After reading Sprague's paragraph, during my stay in Kew I did search for any possible reference to such an author who might have fused the two names into *Cantharospermum* previous to Bentham, but failed to discover such a reference. Even should such an author be produced, this would be one of those clear cases which would call for the incluson of *Atylosia* among the *nomina conservanda* in view of the many specific epithets that would have to be altered in case *Cantharospermum* was adopted in place of the commonly used *Atylosia*. For these reasons in my Flora of Khandala I retained the name *Atylosia* as the only correct one for the genus.

4. Acacia intsia and Acacia caesia?

This group, *Acacia intsia—Acacia caesia* is one that has troubled me for a long time. As a result of much field work I have come to the conclusion that both names refer to one and the same plant at least as far as my Khandala specimens are concerned; the expressions used by Cooke and others on the subject have left me deeply puzzled.

Cooke in his Flora, p. 451, writes: 'This plant (i.e. *Acacia caesia*) is often confounded with *Acacia intsia* Willd., but to anyone who has seen both plants growing, their separation as distinct species presents no difficulty.' Talbot, in For. Fl. 1: 494 adds: 'Prain . . . separates them (i.e. *A. Intsia* from *A. caesia*) . . . and maintains the two as distinct, stating that the crowded leaflets always hairy beneath makes it very easy to recognise *A. caesia* even in a herbarium and that no one dreams of confounding the two when they are seen growing. I agree with this opinion.'

On the other hand, Baker in Fl. Brit. Ind. 2: 297 unites the two plants under *A. intsia,* making *A. caesia* but a variety of the same; Bentham, in Trans. Linn. Soc. 5: 30, and Brand. is in For. Fl. 189, unite the two species into one.

I have examined a number of specimens of apparently both species, and have read carefully through Cooke's and Talbot's descriptions, and cannot find any constant and definite character by which these two species should be separated. The main points for the separation are the pubescence of the leaflets and the presence of glands on the rachises of the pinnae, together with the size of the leaflets. None of these characters seems to me to be constant; I find glands on the pinnae (typical of *intsia*) on leaves which are densely pubescent both on the rachises and leaflets (typical of caesia); pinnae over 12 in number (typical, according to Cooke, of *caesia*) together with glabrous leaves (typical of *intsia*); leaflets overlapping (*caesia*) together with glabrous leaflets (typical of *intsia*).

I have seen both plants growing and cannot see the obvious differences mentioned by Cooke, Talbot and Prain.

Supposing, then, that both names refer to one and the same plant, the next question is what such a plant should be called. Craib in Kew Bull. 1915: 408 writes: 'The writer regards the material examined by him, all of which has been referred to *Acacia caesia* and *A. intsia*, as composed of at least six species. In the enumeration and description of new species it will be noted that full synonymy is not given, the reason being that the species have been so mixed up that short of examining the actual specimens included under either or both species by successive authors, it has been found impossible to decide which particular plant is referred to.' And again on the same page: '. . . the writer feels compelled to abolish the name *M. intsia* altogether, at least so far as the Indian flora is concerned.'

Of the six species mentioned by Craib, only two are found in Bombay State, judging from the material kept at Kew, Dehra Dun and elsewhere; the species are *A. columnaris* Craib and *A. torta* Craib, the latter being by far the commoner of the two in Bombay, and is the plant mentioned above for Khandala.

Acacia columnaris Craib, in Kew Bull. 1915: 410, 1915. Differs from *A. caesia* Willd. in the larger number of pinnae and leaflets, and in the columnar glands on the petioles.

Branchlets at first somewhat tomentose, sulcate, then glabrous, with ashy bark, and thorns about 1-2 mm. long, straight or slightly curved, somewhat densely arranged. Leaves about 8.5 cms. long (the common petiole scarcely 3 cms. long excluded); common petioles at first crisply puberulous, then glabrous, canaliculate above, provided with a gland 2 mm. high near the base; rachis with 3-4 columnar glands in the upper part, with the same type of indumentum as the petioles, on the lower side armed with recurved prickles; pinnae 8 pairs, 5-6 cms. long, shortly petiolate; leaflets 10-17 pairs, oblong, provided with an apiculum which is straight or slightly bent, base truncate; the leaflets up to 1.1 cm. long and 3.5 mm. broad, chartaceous, finally glabrous, shining above, paler beneath, opaque, sessile, nerves prominent beneath, clear above. Capitula about 8-9 mm. diam., arranged in a terminal, ferrugineo-tomentose panicle, the common peduncle about 8 mm. long. Calyx tube sparsely adpressedly ferrugineo-pubescent outside, 1.25 mm. long, lobes 0.75 mm. long, deltoid, acute. Corolla 2.5 mm. long, the upper part of the back slightly ferrugineo-pubescent. Stamens twice as long as the corolla. Ovary pubescent, stalk of the ovary 1 mm. long, glabrous; style glabrous. (Craib, loc. cit. p. 410, trans.)

N. Canara, *Talbot* 622 (Herb. Dehra Dun).

A. torta Craib, in Kew Bull. 1915: 410, 1915.
A. Caesia Wight & Arn., Prodr. 278, 1834, non Willd.
Mimosa torta Roxb., Fl. Ind. 2: 566, 1832.

Bombay Presidency. *Gibson, Gethune, Dalzell* (Herb. Kew.); Concan, *Stocks* (Herb. Kew. and Mus. Brit.); Belgaum, *Ritchie* 1737 (*Herb.* Kew & Edinb.), 1737/3 (Herb. Kew.).

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FORTY YEARS OF SPORT ON LITTLE KNOWN ASSAM RIVERS

BY

W. E. D. COOPER

PART II

(*Continued from p.* 100 *of this volume*)

1935

Boats went off as before early in November and were lent to two friends who had a week's fishing in the Macrup and Upper Barak. W & I had a very pleasant ride and walk over the hills and a wonderful view of the plains, when we stopped for lunch at the top. As the Macrup and the Upper Barak had been fished hard, loaded up the boats and got away down the Macrup. On the way down had quite a battle with a big King Cobra, which, instead of getting out of the way as snakes usually do, came straight for the boat with its head well up. When unpleasantly close I dropped my rod and gave him a charge of shot in the face which knocked him down, but he came up again with hood out, and was only turned by the second barrel, when he scrambled to the bank and was finished off with a bullet. In spite of this stretch of the river having been well fished I picked up ten fish on my light fly rod. W had gone ahead and selected a camp site well below the mouth after driving off a large python he found on the site; he had also landed a 24 lb. mahseer.

November 27th: Left a very pleasant camp and continued down through new and absolutely wild country, following a herd of elephants which were rather spoiling the water. W landed a 24 lb. mahseer and I caught fish on every rod.

November 28th: Reached the mouth of the Irung midday, and found an excellent camp site on a gentle rapid which soothed one to sleep, catching odd fish on the way down. The Irung is a river flowing in from Manipur about which I had often heard travellers' tales. I do not think any European had fished it before beyond the mouth. Came up to expectations; scenery magnificent on a scale half way between the Macrup and the Barak. My diary for the next three days reads:—

'Woke up in our delightful camp, had two leaking boats out for overhaul. They had already been travelling over stones and rapids for a month. Went off up the Irung; W went down the Barak. Got into long cool gorges with magnificent scenery; not much doing in the fish line before lunch; was broken by a big one spinning and landed two smaller ones. Had a splendid afternoon with my little fly rod between the gorges and camp, landing 7 good fish on a Yellow Spider. Got back at dusk to find the camp really well fitted up and W back after a hot and tiring day, with an 18 lb. mahseer. He had been broken by two monsters in spite of having started with an extra strong line. He had also lost another just as he was about to beach it owing to the spoon catch breaking. Plenty of excitement anyhow.

November 30th: Had a good morning overhauling tackle and made rather a late start down the Barak to try and find some of the monsters that broke W the day before. Was quite unsuccessful and could not move a fish spinning at all. River very wide and difficult to fish. Also wasted a lot of time hauling my boat up shallow rapids. W went up the Irung and came back with two good fish caught on the troll in the gorges, also shot a barking deer. He could not touch anything on a fly spoon where I did so well the day before.

December 1st: Made an early start 8.15 up the Irung and got into some delightful country above the gorges at 10.30. River opens out and I should like to explore further. Saw lots of fish. River very clear and shallow, only managed to hook 4 spinning. Weather colder, nothing would move to a fly in the evening in the water where I did so well 2 days ago. Got back to camp rather weary at dusk; W arrived at the same time with his usual fine fish, of 36 lb. This time, also a junglefowl and duck. Spent the evening preparing tackle for the big ones (?), down the Barak to-morrow as we must leave our pleasant camp and move down to the Hattia Rocks, which we hope to get through by the 3rd. The Irung is a fine river and worth exploring higher up where I had not time to fish it properly.'

December 2nd: Down to the Big Gorge and the rocks known as the Hattias where the river narrows down to a few yards and drops suddenly, reaching about midday. We started the porterage after lunch carrying tents and camp equipment for ¼ mile over and under rocks to a sandy bank where the river was quieter, which took till dark.

Left the boats and most of the crew except personal servants above the waterfall which was not nearly so bad as expected. Scenery wonderful if somewhat awe inspiring with steep cliffs overhanging the river, from which in the monsoon huge rocks roll down into the river bed. My diary for the next two days reads :—

'An experience getting boats through the Boro Hattias, but no fishing. Boatmen packed the *mahl* through in the early morning. W at one end, I at the other. It took 4 hours to get 6 boats through, which was accomplished without accident barring the loss of the long rope. Were unable to move camp after a hard day for everyone. Dropped down to see what the Chota Hattias were like. May have to make another porterage. My boy Mongrew very sick with bad fever. Have seen nothing to shoot; weather colder. A Kooki appeared in camp, said he had seen a tiger lower down.'

December 4th: Left camp in good time, glad to get out of the impressive but rather depressing gorge. Water in Chota Hattias much better than we expected, but like others before us we had to pay the price of visiting this stretch of the river. Brought our boats without difficulty through some heavy water in which one had to shoot a narrow opening in a ledge of rock, and left two boats to follow. I was fishing down the rocks, W having gone on with his troll out when I heard yells from behind and returned to meet our tents and other things floating down the river. The fool of a boatman, having seen all boats shoot the ridge, had a brainwave and put a rope on it which swung it across the current. Boat upset. Recovered a good bit of stuff and wasted two hours, spoiling my fishing. Chief loss, all our plates, knives and forks, cups, sparklet bulbs, spares for petrol lamp, some of the boatmen's cooking utensils and a bottle of whisky. Met W at the mouth of the gorge wondering what had happened. We must feed straight out of tins with one fork for the rest of the trip for this unnecessary accident. Came down below Bagh Chur and brought the boats on to Ledge Camp where I decided to stay and dry the wet things as it was too late to make Tepi'. Water looked perfect but fish were not taking and I could only fish a short time; W had a 2 lb. carp only. The crew had lost most of their dried fish.'

We spent most of next morning drying out things, camped below the mouth of the Tepi' on a very windy spot and made for Minadhur. My diary records some rather unsuccessful fishing en route which did not add much to our total of 60 fish weighing 264 lb.

December 6th: Both had a good night on the somewhat bleak spot. W left ahead and I followed, behind the camp. Both had a day of thrills with no luck, partly due to homemade tackle and being snagged. I did not touch anything in the morning, but W in front, got into three Tigers, trace broke, hooks broke and the third snagged him at the top of Kommandhur: he only landed three small ones. I hooked a big one after finding W snagged with another in the submerged logs we know so well, but he tore the catch out of a homemade spoon, which condemns that type of mount. In the long reach between Kommandhur and Minadhur I saw a big one chasing small fish, put a No. 7 spoon over him which he took at the third cast and went upstream like a steam engine with plenty of line and everything free. Unfortunately he ran into a submerged log with branches, and though I had him on some time another rush broke the line, of which I lost 20 to 30 yards. Found camp at Minadhur hardly pitched, everyone very tired. We have given the men rather a roasting; should have taken another day over it. No bath tonight. Spoons and forks made of bamboo very successful. Am feeling ten years younger for the trip, which, though accidents have been common, has been full of tense moments. Shot several pigeons for the crew.

1936

As H. E. the Governor was doing a tour in the hills and wanted to fish the Macrup and Upper Barak he asked for the loan of my boats and boatmen which were duly despatched through the Hattias in time to meet him at the Macrup mouth. My eldest son was with me on leave from Africa so arranged to take over the boats when H. E. had done with them and come down through the Hattias with one of his guests, a keen fisherman and an old friend of mine.

J and I did the journey to the Macrup much as on previous occasions meeting the Government House party en route who told us they had done well on the Macrup with their fly lods, landing about 100 fish, but had nothing over ten pounds. We were met at the Macrup Bridge by one of my boats and arrived at the Governor's palatial camp 100 ft. above the river where we found B over a camp fire, and had some difficulty in selecting which of the various bamboo buildings we should occupy. I did not fish as much as usual this trip as I had two guests and my head man was laid up with bad malaria most of the time. When fishing the Macrup, E. E. had fallen into a rapid from which he was rescued by my boatmen, but lost his rod swept into the pool below and from which Okhai had retrieved it after swimming and diving for half an hour on a cold evening. He was duly rewarded of course, but was of little use to me for the rest of the trip and I had to spend more time than usual in camp control. My boy J had not fished for mahseer before so spent most of my time down to the mouth of the Irung, showing him where and how to fish. The following extracts from my diary give an idea of the sort of fishing we had and how we got through the Hattia rocks and Long Gorge :—

December 3rd: 'A good night and a good dinner. H. E.'s second cook we had taken on; doing us well. B up the Irung, J and I up the Barak, did not move anything till midday when a 20 to 30 lb. fish came right out of the water and took my spoon spinning a run, went off like a motor car but unfortunately got my line round a snag and I lost 20 yards of spinning line, a thrill however. I have never seen a mahseer come right on top of the water like that. Had lunch in a cool spot, trolled a bit, then tried a fly, also J, who is becoming expert, soon had 2 mahseer of 4 lb. Fish taking well for an hour and found B in camp with half a dozen, one of which he had hooked in the tail. He had also been broken by a good one, Okhai ill again and we leave for Hattias tomorrow.

December 4th : J and I left our pleasant camp ahead, B following behind the *mahl* boats, spun and trolled down to Hattias with no result as in the previous year. Arrived 12.15 just ahead of *mahl* boats and selected a good camp site just above the big rocks. B turned up with one small fish only. Fished up after lunch, lovely looking water but very fast and no use for a fly; one other fish caught. Climbed down to below the waterfall at 4 p.m. and, to my surprise met the Manipur State Engineer with another expert and a working party of Kookis, doing an Electric Scheme Survey. They had a camp below the Chota Hattias and had marched here in 12 stages, were expecting boats to take them down river and were practically out of food with absolutely no drink. He promised to send his Kookis to help us with the porterage, which he did next day, but could not stop as they had a long trek over rocks to their camp. Okhai better to-day, came down in our boat; saw lots of game tracks but no game.

December 5th: After a good night alongside a roaring torrent that sounded like the sea, J and I went off with three boats, dumped the *mahl* at the top of the waterfall and proceeded to get the boats through. Found the engineers there again with 20 Kookis which helped no end with the porterage. With their aid we had all the boats through by midday, managed to do away with the long rope business. Let the empty boats go with men standing by with long bamboos to push them off the rocks; quite successful. Lunched and came on ahead of the *mahl* boats as there were one or two places in the Chota Hattias where we upset a boat the previous year, requiring care. We were clear of the Hattias by 2 p.m.; no time to fish and could have gone further but stopped opposite the engineers' camp and asked them to dinner just above Tiger Camp. We had got through the Hattias in one day, a record. The engineers have a big camp here with Kookis and boatmen sent up to take them back; 60 or 70 souls in a place I never saw a human being in before. We had a cheery dinner party on our sandbank and put up a plum pudding. As they had been out of liquor for days a little gin went to the expert's head quickly and he kept us cheerful. We gave them a small tent, some stores and a bottle of grog to see them down the river and they left early next morning. Okhai better; cook being doctored for a cut hand.'

The good camping ground at the mouth of the Tepi' being occupied, dropped down to a rather cold and windy camp below, where our troubles began. B was stung or bitten by something putting wood on the camp fire; his hand and arm were badly swollen next day. J, feeling a bit off colour, went up the Tepi' with me and had quite a good afternoon with our fly rods landing 10 fish; best 6 lb. J collapsed on return to camp so put him to bed with aspirin and hot toddy; then his bed collapsed so gave him mine and wrapped him up well. B and I dined in his tent, the only time I remember dining anywhere but in front of the camp fire in the open, in all these trips. We decided to move down to a sunnier camping ground I knew of lower down, so went on and fixed the camp.

Both my guests rather crocks, but managed to shoot a junglefowl each for dinner. Put J to bed and left B in camp much better, but on my return found B's bearer and the cook down with fever so decided to send a light boat down to W to ask him to send the motor boat up a day earlier than arranged. My diary of the next two days reads as follows:—

December 9th: 'J's throat still bad so he stayed in bed and I sent off a light boat with 3 boatmen at 7.30 a.m. B's hand better, so we went upstream in the morning. I caught a small mahseer and B landed 3 fish, being broken by two big ones and losing another. I returned to camp for tea to doctor my patients; missed a wild dog from a shaky boat on the way down. Visited by lots of Nagas and distributed tea and chocolate to the children, having exchanged a blanket for oranges in the morning. Found J pretty comfortable but throat still bad; no temperature. Okhai and my bearer down below the camp heard a tiger kill a pig, but left it alone. Big fish not taking at all; B pulled his out of the rocks with a fly spoon.

December 10th: J much better, camp very comfortable. A goosander flew up river after breakfast which I shot. We then went ahead in one boat, shot pigeons and rolled a gharial over but it just managed to struggle into the water and got away. Kommandhur 11 a.m. J trolled down the two runs, the spots where W and I have caught many good fish; so did I, but nothing took. B came down later and was broken by a monster in the top run where snags are bad. I hooked a fish spinning in the bottom run, but he was off immediately. Had lunch in the shade, after which J went up to the top run and landed a 26 lb. mahseer after breaking his rod. A good effort which pleased everyone. As a beginner he had the best fish of the trip. B landed a 10 lb. fish lower down and two smaller ones. He has been unlucky in losing all his big fish. Arrived Minadhur 5.30 p.m.'

Motorboat arrived next morning and took aboard all the invalids, I with them feeling perfectly fit but developed a bad attack of ague and fever on the way down so was quite glad to get home. This was the only time in many years camping in the cold weather that I had any sickness. This I put down to our night in the Governor's camp which was in big tree jungle full of mosquitos, no doubt infected by the numerous camp followers who had been there. My camps were always on sandbanks as near the river as possible and free from mosquitos. On this trip we landed 94 fish weighing 200 lb., having lost most of the big ones hooked. B, I think, was using too light hooks for big mahseer.

1937

W and I decided to repeat our very successful trip of 1933 and fish the Upper Barak and Macrup. Boats went off on November 6, and were at the bridge in 11 days. We joined them on the 18th, an improvement in time all round. Found the river very low and the fishing was not as good as usual. Camped on a very noisy rapid just above the mouth and W came in with two good mahseer 19 and 20 lb. the first evening there. I had several smaller fish and broke my old Hardy of some 30 years service in a 4 lb. mahseer which I landed with the top floating in the water. Fixed up an old light bamboo trolling rod with a fly spoon which worked well, and landed several fish as they were not taking a fly at all freely. My diary of the 24th records the following which was typical of the sort of days we had:—

'Both went down, I first, and had an interesting day. Landed an 18 lb. mahseer on the troll and waited for W at the spot I fixed for our next years camp. W went on and I fished down to the bottom of the long reach where I shot the sambar in 1933. Left a pair of shoes and stockings on a tree and found them a year afterwards indicating a scarcity of human inhabitants. Ran several fish and got a mixed lot on a fly spoon, one of each, masheer, "pakhi runga", carp, and gugal. W caught me up at 4 p.m. ; he had a 7 lb. fish only and had struck some hot dull reaches down below. Have not fired a shot at anything yet, a record for 3 or 4 days on these rivers.'

Our last camp at the Macrup Bridge with the 5,000 ft. Kalinugger above us, though we did not realise it at the time, neither did we imagine, that within five years this bridge and the paths leading to it would be the route by which some 50,000 refugees would make the last lap of their escape from Burma to safety. Our catch for the week was 46 fish weighing 152 lb. only. We managed to have fresh fish for dinner every night.

1938

November 27th: I am quoting the log of my last trip in full as we had reduced the time factor to a minimum and I now knew in detail every stretch of the 150 miles of river covered in these journeys. We had hoped to have explored the upper reaches of the Irung, but that has to be left to someone else. A friend who joined us in 1928 did it in 1940 and wrote, 'We got some good fish. B lost a huge one he had on for hours when his reel broke. The Irung Gorge, about two days up, is far worse than the Hattias to get through, and really dangerous. The sun only shines in it about an hour a day as it is sheer on both sides with terrific cliffs, everything damp and sinister with very heavy water. Above that one comes out into a stretch of river where it flows across a plateau and on the banks are regular stone ramps which the Nagas and Kokis fish from. The fish were line shy but plentiful; they get line shy from seeing so many of their friends on night lines.'

I was leaving India for good next year so W and I decided on a short trip up the Barak to the happy hunting grounds where we had both caught our first mahseer; I, some 30 odd years before.

Left home 7 a.m. Joined W at Lakhipur Ghat 7.30 and had an excellent run in the motor boat to Minadhur with a boat tied alongside containing the cook and provisions. Had lunch at M. Boat Camp completely changed and reached Minadhur where our camp had been sent. River high but clearing. Found camp pitched and all well. Okhai had shot 6 junglefowl and some pigeons so, with a Butchwa we acquired on the way up, we dined well. Saw two gharial on the way up very close; they did not seem to mind the motor boat, but I did not fire. Fish jumping at the top of the rapid, so got out my spinning rod and landed a 12 lb. mahseer with two of 5 lb. before tea, being broken by another just before dark.

November 28th: Very comfortable camp at Minadhur. Caught another 7 lb. mahseer spinning before breakfast and were away for Kommandhur about 9 a.m. both being towed by the motor boat, which we sent back from the Naga village to tow *mahl* boats in relays. Water very dirty at Kommandhur where we expected to catch fish. The rapids were full of elephants and timber. I went off after lunch with the *mahl* boats. Water heavy and did not reach our camping ground till 4.30, so got down to it and fixed camp. W arrived with the last two *mahl* boats at dusk and was surprised to find tents pitched, fires and lamps going. He had shot several pigeons on the way up. Water unfishable due to elephants, but we are above them tonight; no rain and cooler. Camped where J, B and I did in 1937 well on our way to Tepi' in two days.

November 29th: In spite of a late camp were very comfortable. W left ahead and I after the *mahl* boats. Another long trek and neither of us could move a fish in the long reaches and shallow, fast rapids. Found camp pitched on a small stony bank just below the Lal Pahar (Red Hill) so should be at Tepi' by midday tomorrow. Boys rather done up; will be glad of a day or two in permanent camp. W shot a junglefowl; otherwise no sport of any sort, but river much clearer. No fish for dinner tonight. Left camp 9 a.m. and struggled up very heavy water to Tepi' Mukh, the Barak too big and dirty to be fishable, but the Tepi' perfect. Went up ¾ hr. to the spot I camped on 30 odd years ago, selected camp site and waited for *mahl* boats which arrived 1.30. Ran a fish or two on fly spoon and caught a small one. We had made the Tepi' in 2½ days paddling, against 7 days on my first trip—thanks to motor boat.

November 30th: Went up the Tepi' 2 p.m. and had splendid fishing in the first long reach. Finished up with an 11 lb. mahseer which gave me good sport. Fish taking a small spoon better than a fly; water not too clear. W had slogged up the Barak trying for a big one, but only had two small fish on the troll and had shot a monitor.

December 1st: Am sitting in front of a roaring camp fire after a long day in the cold Tepi' gorges and first rate fishing. W went from our very comfortable camp to try for a big one again in the Barak. I was up my old love the Tepi' to find the waterfall was no more, and got above where it used to be, and into some good fish after ½ hour spent hauling my boat up, higher than I had ever got before. Fishing good from 12 o'clock till 4 p.m. with both fly and spoon. I landed 18 fish mostly on Yellow Spider. Got back late to find W there with an 18 lb. mahseer; my 18 weighed only 27 lb.

December 2nd: W went off early up the Tepi' to see if he could get a big one trolling in the top gorges and do some casting. He came back with a small carp and a junglefowl. I went up the Tepi' a reach or two, but could not move a fish on either fly or fly spoon so stopped at 12 o'clock, read a book and took it easy till 1.30 in a shady spot of old memories. Had a good afternoon, was broken by what must have been an 8 lb. mahseer on my trout rod after having had it on for 10 minutes, and seeing it several times. Cast went at top so may have been weak there as I cut off the lower end at lunch. Put on a new cast and landed two good 4 lb. fish later as well as some smaller ones. White ants rising about camp but fish would not take any fly I had which is unusual. We have decided to do one more day here. Have not opened a tin so far; I had 10 fish for the afternoon.

December 3rd: Weather and camp perfect. W went up the Barak still hoping for his 30 pounder; I went right up the Tepi' again, did not fish till 12 o'clock as fish did not take till the sun had been on the water. Started with three good carp at midday in the top gorge. Had lunch and the best afternoon with the fly rod I have ever had, landing 18 fish, 7 of them over 4 lb. Was only snagged and broken once, mostly caught on No. 1 fly spoon as, for some reason, they were taking this better than the fly. Finished up with a 4 lb. mahseer almost in the dark; probably my last fish from the Tepi', where I started my fishing career in India 35 years ago. A sad thought as I have only pleasant recollections of this beautiful little hill river, which in spite of orange groves and cows has never let me down. W came in with pigeons but no fish. The big river banks where he got his 18 pounder had fallen in and made the river almost unfishable.

December 4th: With the sun breaking through the mist on the hills, struck camp on the Tepi' and said goodbye with a lump in my throat and the usual chorus from gibbon monkeys bidding farewell. W went down ahead and I a couple of reaches up to let the camp get off. No fish taking in the morning; only one small carp. Was down at the mouth 11.30 passing the camp en route. Started to troll down with a dead bait, got into something big in the gorge below the mouth which came down stream and snagged me at once; got off with the loss of dead bait and tackle. Lunch at Putikhal. Immediately afterwards another fish snagged me in very dirty water and deep, so had to cut the line and lost spoon and trace. Barak still very full and impossible for anything except trolling. Reached Ainadhur 4.30; W came in just after with two small fish caught on the troll.

December 5th: Left camp at Ainadhur in front and dropped down to Kommandhur, usually the best place for big fish in the river. This year, however, owing to late floods the banks were falling in and it was dirty and unfishable. Had lunch with W and dropped down to our first camp at Minadhur where the rapid was clear and I caught four good fish on the way up. Spotted a fish feeding, crossed the river with my spinning rod and got him. Saw another real big one feeding in the middle of the river, so when W arrived signalled him to come down with his troll out and actually saw the fish, which was just opposite me, take the spoon and landed in front of our tents. It weighed 24 lb. W also got another, 6 lb. further down the river, and some pigeons.

December 6th: Kept my last camp fire burning all night. In all these years have never let one out, and blew my last whistle for tea at 6.15 a.m. Saw a fish feeding whilst having tea so spun over him in pyjamas and landed a 4 lb. mahseer. Fish were not feeding after breakfast so left 10 a.m. and selected W's Christmas camp site suitable for ladies, near the old Island Camp which has gone. Had a good run down in the motor boat with three fish tied in banana leaves under the roof to keep cool. Everyone inspected the 24 lb. mahseer, and I took the smaller one home to put in the frig. A pleasant and successful trip to wind up some of the happiest days of my life in beautiful country with good companions, both European and Indian who I believe enjoyed it as much as we did, with plenty of hard work pulling up rapids and usually plenty to eat, in the country where no letters, telegrams or papers could reach one, and where money would buy nothing, the few hill people we met infinitely preferring tea or blankets. I salute the boatmen who kept one's boat exactly the right distance from which to put a fly or a spoon over a fish. I shall remember them all over the fire on a winter's night in England, especially W and his good wife, who, whatever little I may have taught him about catching mahseer, taught me how to camp in comfort. My trips with him were very different from those of earlier days when I was younger, when we often slept on the ground with a tarpaulin for covering, lived on turtles eggs and what we could shoot.

On the last trip I landed 63 fish weighing 135 lb.; W, 8 fish weighing 63 lb. Also, with Okhai's assistance, shot some 20 junglefowl.

FISHES FROM THE HIGH RANGE OF TRAVANCORE

BY

E. G. SILAS, B.SC. (HONS.).

From the Laboratories of the Zoological Survey of India.

(Communicated by Dr. S. L. Hora)

(*With two text figures*)

INTRODUCTION

Travancore has not remained a *terra incognita* to the fluviatile ichthyologist. A perusal of the literature shows that, since the publication of Day's 'Fishes of Malabar' (1865) and 'Fishes of India' (1878-1888), a considerable amount of work has been carried out, especially during the past two decades. Situated at the extreme south of Peninsular India, Travancore has been noted for its richness in the number and variety of freshwater fishes, so much so that with every fresh collection new records, or species new to science, have been discovered. The freshwater fish fauna is also noted for its high endemicity. A marked Malayan element in its fauna, is yet another feature of considerable interest.

In recording 76 species as occurring in the freshwaters of Travancore, Hora and Law (1941) surmised that further research would bring to light more species of freshwater fishes from this interesting zoogeographical region. Since then the addition of nearly a dozen freshwater species have been reported from Travancore. Some of these are new to science. Raj (1941), described a new species *Barbus* (*Puntius*) *ophicephalus*, and a subspecies, *B.* (*Puntius*) *micropogon periyarensis*, from Kallar, a tributary of the Pambayar river and from the Periyar Lake respectively. Hora and Nair (1941) redescribed a rare gobioid fish, *Sicyopterus griseus* (Day), from Southern Travancore and a new species of Globe-fish of the monotypic genus *Monotretus* Bibron, viz. *Tetraodon* (*Monotretus*) *travancoricus*, from the Pambayar river in Northern Travancore. Chacko's list of indigenous fishes of the Periyar Lake (Chacko, 1948), includes the following species not previously listed from Travancore: *Barilius bendelisis* Ham.; *Silonopangasius childreni* (Sykes) (=*Silundia sykesi* Day); and *Anguilla bengalensis* (Gray). In 1949, the writer extended the distribution of *Barbus* (*Puntius*) *dorsalis* (Jerdon), to the fresh waters of Travancore. Recently Menon (1950) reported the discovery of a remarkable blind Cat-fish, *Horaglanis krishnai* from Kottayam. The present collections by the writer (Silas, 1951) from the hill ranges of Travancore show the extended distribution of two other species, viz. *Nemachilus denisonii* Day, in the Peermēd Hills in Northern Travancore and *Esomus barbatus* (Jerdon), in Southern Travancore.

This paper is a continuation of a previous contribution by the writer (Silas, 1951), and deals with the fishes of the High Range of Travancore. The above list of new records shows that six species have been reported since 1941 (Hora and Law), as occurring in the hill-streams and rivers draining the High Range. They are :—

Barilius bendelisis Ham.
Barbus (*Puntius*) *micropogon periyarensis* Raj.
Barbus (*Puntius*) *ophicephalus* Raj.
Nemachilus denisonii Day.
Silonopangasius childreni (Sykes).
Anguilla bengalensis (Gray).

To add to these the occurrence of two other remarkable genera described from here recently, viz. a homalopterid, *Travancoria* Hora (1941), and a schizothoracin, Lepidopygopsis Raj (1941), show how rich a fauna this part of Travancore possesses. In May and June 1950, while on a visit to the Peermēd hills, the writer was able to make fish collections from certain places from this part of the High Range, and it is the object of this note to report on the material then collected.

TOPOGRAPHY

The High Range proper includes some of the highest peaks in the Western Ghats. In the south, especially towards the Peermēd section, the land spreads out into considerable width, with the hills rising upto about 5,000 feet. These ranges are topographically important because, due to their abrupt rise and closeness to the sea-board, they help in checking the South-West Monsoon clouds and give heavy rainfall to the narrow strip of land to their west. These hills also enjoy a maximum rainfall of about 200 inches. The efficient natural drainage system draining the western face of the High Range consisting of innumerable winding perennial streams and rivulets, harbour a very interesting fauna.

DRAINAGE SYSTEMS

The High Range is drained by streams which ultimately empty into four main rivers, viz. the Amaravati and the Vaigai on the east, and the Periyar and the Pambayar on the west. Chinnar, a tributary of the Amaravati river, takes its origin from the High Range proper and joins the Amaravati in the plains. The Amaravati in turn becomes confluent with the Cauvery further east. The Suruli, a tributary of the river Vaigai, and the Vaigai itself drains part of the eastern face of the High Range. The Periyar, which drains a greater part of the western face of these hills, ultimately empties into the sea near Cochin. The Pambayar river flows into the Vembanad lake and is not directly connected to the sea. As a result, it has been possible to divide the drainage system into four main watersheds. They are the Cauvery and the Vaigai watersheds on the east, and the Periyar and the Pambayar on the west. Collections have been made from the Periyar and the Pambayar watersheds. The nature of the watersheds, and the localities from where collections have been made, are indicated in the accompanying map.

DESCRIPTION OF LOCALITIES

To obviate repetition of describing the environment of each species separately, the following brief description of the places of collection is given below. The species are arranged under each locality in the table at the end, and by referring to these descriptions the characteristics of their respective habitats may be ascertained.

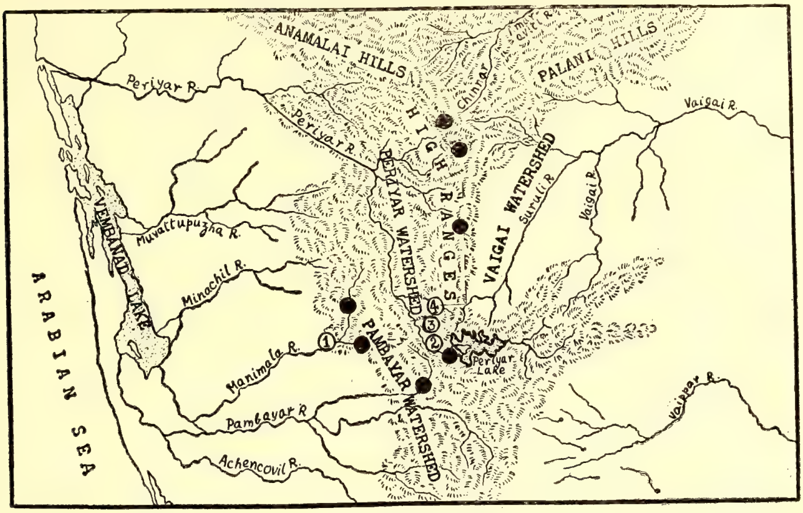

Fig. 1

Map showing the watersheds of the High Range and the localities from where fish collections have been made. (1) Manimala river, Mundakayam, (2) Vandiperiyar river close to Arnakal Estate, Peermēd Hills. (3) Stream in Garadygody Estate, Peermēd Hills. (4) Upper and Lower Pasupara streams, Peermēd Hills. The black circles indicate localities from where previous collections have been reported.

(i) Large stream at Mundakayam, (Manimala River): Typical large hill-stream at the base of the Peermēd Hills. At the time of collection, due to the then prevailing drought, the level of water had gone down considerably and consequently the flow in the stream was also moderate. The bottom is mostly rocky, strewn with stones and pebbles in some places, and muddy in others. A few large pools with generally sandy bottom are present along the course of the stream.

(ii) Vandiperiyar River close to Arnakal Estate, Peermēd Hills: Large river. Due to the then prevailing drought, the flow of water in the river was greatly restricted. In certain places, the water flows over a bed of rocks. The current was not very fast, except in the region of small falls and cascades. A few large and deep pools were present along the course of the river. Aquatic vegetation was found to be practically absent at the time of collection. But plenty of vegetation was present on either bank.

(iii) Stream at Garadygody Estate, Peermēd Hills: Small stream, portions of which were overgrown with plenty of vegetation. Pebbly and shingly bottom intermixed with sand.

Small pools were present along the course of the stream. The current was generally sluggish, except between pools where rapids are formed.

(iv) Upper Pasuparai Stream, Peermēd Hills: Typical large hill-stream, two miles beyond Pasuparai Estate, formed of rapids and pools in succession. The stream flows along a wooded valley. Conditions are almost similar to those observed in (ii) above.

TABLE

Name of Species	*No. of specimens obtained*	*Standard length*	1	2	3	4
Family CYPRINOIDEA						
Sub-family Abramidinae						
Barilius bakeri Day	6	45–93	×	×	—	×
Barilius gatensis (Cuv. and Val.)	14	47–97	—	×	×	×
Sub-family Rasborinae						
Danio aequipinnatus McClell	19	48–96	×	×	×	×
Rasbora daniconius (Ham.).	31	38–115	×	×	×	×
Sub-family Cyprininae						
Barbus (*Puntius*) *amphibius* (Cuv. and Val.)	1	97	—	—	—	×
Barbus (*Puntius*) *curmuca* (Ham.)-	5	54–193	×	—	—	×
Barbus (*Puntius*) *filamentosus* (Cuv. and Val.)	7	78-189	×	×	—	—
Barbus (*Tor*) *khudree malabaricus* (Jerdon).	2	165–256	—	×	—	—
Barbus (*Puntius*) *melanampyx* Day	40	29–58	×	×	×	×
Barbus (*Puntius*) *micropogon periyarensis* Raj	1	76	—	×	—	—
Barbus (*Puntius*) *ophicephalus* Raj	1	128	×	—	—	—
Garra jerdoni Day.	1	151	—	—	—	×
Garra mullya (Sykes)	27	52–149	×	×	×	×
Family HOMALOPTERIDAE						
Bhavania austrilis (Jerdon).	2	73–113	—	×	—	×
Travancoria jonesi Hora.	1	90	—	—	—	×
Family COBITIDAE						
Lepidocephalus thermalis (Cuv. and Val.)	29	51–71	×	×	×	×
Nemachilus denisonii Day.	11	41–64	—	×	—	×
Nemachilus guntheri Day.	3	70–76	—	×	—	—
Nemachilus triangularis Day.	4	85-89	—	×	—	—
Family HETEROPNEUSTIDAE						
Heteropneustes fossilis (Bloch).	1	182	×	—	—	—
Family SILURIDAE						
Ompok bimaculatus (Bloch).	1	76	—	×	—	—
Family BAGRIDAE						
Mystus cavasius (Ham.)	1	73	×	—	—	—
Glyptothorax madraspatanus Day	4	111–166	—	×	—	×
Family CYPRINODONTIDAE						
Aplocheilus lineatus (Cuv. and Val.)	17	36–69	×	×	×	×
Family GOBIIDAE						
Glossogobius giuris Ham.	2	71–74	×	—	—	—
Family OPHICEPHALIDAE						
Ophicephalus gachua Ham.	16	69–112	×	×	×	×
Family MASTACEMBELIDAE						
Mastacembelus armatus (Lacép).	9	123–304	—	×	—	×

(v) Lower Pasuparai Stream, Pasuparai Estate, Peermēd Hills: Fairly large sluggish stream with plenty of outflow over a bottom of sand and stones. In certain places the bottom is muddy. Plenty of shade is afforded by overhanging branches of trees on either bank. A certain amount of aquatic vegetation was present at the time of collection. The stream is fairly deep in certain places, but no deep pools were present where collection was made.

In addition to the above mentioned localities, collections were also made from smaller streams in their vicinities. The following table (p. 326) indicates the species obtained by the writer from the different localities. The total number of specimens of each species and their standard lengths are also given. The localities from which the specimens were obtained are for convenience, numbered as:—(1) Stream at Mundakayam, Manimala River; (2) Vandiperiyar river close to Arnakal Estate, Peermēd Hills; (3) Stream in Garadygody Estate, Peermēd Hills and (4) Upper and Lower Pasuparai streams, Peermēd Hills. (See table on p. 326).

In all 257 specimens pertaining to 27 species of 18 genera, falling under 11 families were obtained. Except for the species collected at Mundakayam, which is in the Pambayar Watershed, all other species are from the Periyar Watershed.

In order to make the faunistic account more complete, species recorded by earlier workers and not present in the above list are given below. In his list of fishes from Travancore, except for *Barbus (Puntius) denisonii* Day, Pillay (1929) has not referred to species as having been taken from any locality in the High Range. John (1936), has specially mentioned Munnar, Devikulam and the Peermēd Hills for the species *Barbus (Puntius) denisonii* Day and *Nemachilus triangularis* Day. Hora and Law (1941) have recorded the two species *Rasbora rasbora* (Ham.) and *Mystus malabaricus* (Jerdon), not included in the above list, from Pambadampara in the High Range. Chacko's faunistic list of fishes from the Periyar Lake (Chacko, 1948), includes the following species not in the present collection: *Notopterus notopterus* (Pallas); *Chela boopis* Day; *Barilius bendelisis* Ham.; *Barbus (Puntius) melanostigma* Day; *Barbus (Puntius) sarana* (Cuv. and Val.); *Catla catla* (Ham.); *Lepidopygopsis typus* Raj; *Nemachilus evizardi* Day; *Silonopangasius childreni* (Sykes); *Mystus vittatus* (Bloch); *Anguilla australis* Rich.; *Anguilla bengalensis* Gray; *Ophicephalus striatus* (Bloch); and *Macrognathus aculeata* (Bloch).

Thus at present about 44 species are known to occur in the High Range of Travancore. Short notes on certain species of interest in the present collection are given below. The loach *Nemachilus denisonii* is recorded from Travancore for the first time.

Barbus (Puntius) micropogon periyarensis Raj.

1941 *Barbus (Puntius) micropogon periyarensis*, Raj, *Rec. Ind. Mus.*, XLIII, p. 379, fig. 3-4.

1 specimen, Vandiperiyar river close to Arnakal Estate, Peermēd Hills.

I have compared this interesting form with the type in the collection of the Zoological Survey of India, Indian Museum, and find that they agree in all essential features. In possessing 44 scales on the lateral line and 19-21 predorsal scales, this subspecies is sufficiently distinct from *Barbus* (*Puntius*) *micropogon* (Cuv. & Val.), which has only 38 to 39 scales along the lateral line and 12 predorsal scales.

Barbus (Puntius) ophicephalus Raj.

1941 *Barbus* (*Puntius*) *ophicephalus* Raj. *Rec. Ind. Mus.*, XLIII, p. 376, fig. 1-2.

1 specimen. Large stream close to Mundakayam, at the foot of the Peermēd Hills.

Raj (1941) described this new species from Kallar, a tributary of the Pambayar river south of the Periyar Lake. Though this species shows a certain amount of similarity to *Barbus* (*Puntius*) *lithopidos* Day, it is distinguished from it in characters such as the lesser number of dorsal rays (3/7 versus 4/9), the greater number of lateral line scales 43-45 versus 37-39) and predorsal scales (15-17 versus 11-14). The colouration of the species is also very characteristic. In spirit, the lower half of the body is lighter than the upper half. A broad dark band runs along the lateral line from behind the head to middle of the base of the caudal fin.

Nemachilus güntheri Day.

1941 *Nemachilus güntheri.* Hora & Law, *Rec. Ind. Mus.*, XLIII, p. 250, Pl. ix, figs. 2-6.

3 specimens. Stream in Pasuaparai Estate, Peermēd Hills.

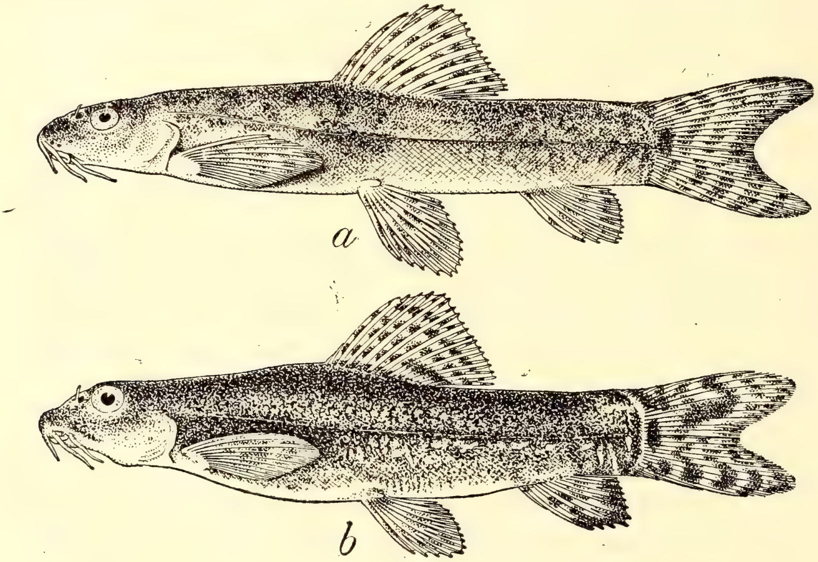

Fig. 2

Lateral view of *Nemachilus güntheri* Day (female specimens) showing colour variations.

In their account on the 'Freshwater Fishes of Travancore' Hora and Law (1941), have redefined this species from two specimens obtained from Pambadampara, High Range, in comparison with specimens from other places. The colour pattern varies to a certain extent in the specimens under report. In the fresh specimens, the ground colour is pinkish, the sides being coarsely reticulated with olive brown markings. Considerable difference in the nature of the reticulation is seen in the specimens under report. A black band is present at the base of the caudal fin. The caudal has from 4 to 6 V-shaped dark bands on it. The paired fins and the anal have 2 to 3 lighter bands on them. The ventral median surface in front of the pelvic bases is light yellowish in colour without any markings. Faint brownish reticulations are present on the ventral surface behind the pelvic bases.

Nemachilus denisonii Day.

1878, *Nemachilus denisonii* Day, Fish. India, p. 617, Pl. CLIII, fig. 5.

4 specimens. Vandiperiyar river close to Arnakal Estate, Peermēd Hills.

7 specimens. Stream two miles beyond Pasuparai Estate, and from the estate streams. Peermēd Hills.

Eleven specimens, measuring 41 to 64 mm. in length, are referred to this species. *N. denisonii* was so far known from the Nilgiri and Coorg Hills, the rivers at their bases, Mysore and the Deccan. Das (1939), referred certain specimens from Hazaribagh District in Bihar to this species. The present record from the Peermēd Hills extends the distribution of this species from the north in the Nilgiri Hills, across the Palghat Gap further south. A certain amount of variation in the colour pattern is discernible in the specimens in relation to their length. The sides of the body in the smaller specimens have 9 to 11 vertical dark bands which coalesce dorsally with those of the opposite side. The ventral median surface is light yellowish without any markings. The lighter alternating bands on the body are narrower than the dark bands. In older specimens the vertical dark bands on the sides in front of the dorsal fin coalesce and become indistinct. The head is marbled with fine black dots. The dorsal possesses two dark blotches at its base, corresponding to the dark bands beneath it. The dorsal fin is marked with two rows of fine black dots. The caudal possesses 3 to 4 irregular dark bands. A dark bar is present at the caudal base. All other fins are pale whitish in colour.

Travancoria jonesi Hora.

1941 *Travancoria jonesi* Hora, *Rec. Ind. Mus.*, XLIII, p. 230, Pl. viii, figs. 5-6.

1 specimen. Stream two miles beyond Pasuparai Estate, Peermēd Hills.

A single specimen of this remarkable homalopterid fish was obtained from the large stream close to Pasuparai Estate. This is the second locality for this species in Travancore. The species was described from specimens collected at Pambadampara, 50 miles north and later recorded from the Anamalai Hills (Puthutotam Estate, close to Valparai town).

Bhavania australis (Jerdon).

1941 *Bhavania australis* Hora, *Rec. Ind. Mus.*, XLIII, p. 225, Pl. viii, figs. 1-3.

1 specimen. Stream in Pasuparai Estate, Peermēd Hills.

1 specimen. Vandiperiyar river close to Arnakal Estate, Peermēd Hills.

Hora (op. cit.), has given a complete diagnosis of this species and discussed its affinities with other Homalopterid genera. *B. australis* seems to be fairly common in the southern portions of the Western Ghats. In the possession of greatly restricted gill-openings, *B. australis* is distinguished from the *Travancoria Jonesi* Hora.

ACKNOWLEDGEMENT

I am deeply indebted to Dr. S. L. Hora, Director, Zoological Survey of India, for the facilities he gave to me to work out the collection, and for his helpful suggestions and guidance. My thanks are also due to Mr. M. S. Joseph, Assistant Superintendent, Pasuparai Estate, who was of great assistance and help to me during my collection trips.

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THE BUTTERFLIES OF BOMBAY AND SALSETTE

BY

A. E. G. BEST

From June 1948 until the beginning of March 1950 I devoted practically every weekend to the collecting of butterflies on the island of Salsette, and covered practically the whole of this area.[1]

I found the best places were the jungle paths round Tulsi Lake, the trolley line between Vihar and Tulsi Lakes, the path from Tulsi Lake to Kanheri Caves, the top of Trombay Hill and the thick jungle at the bottom on the south-eastern side of Trombay Hill.

The higher hills round Tulsi Lake were all visited, and the walk from Thana over the hills to Ghodbunder was undertaken more than once. But these higher hills did not prove of much interest and very few good butterflies were seen. On the other hand, the top of Trombay Hill proved a very good collecting ground, particularly for *Charaxes polyxima imna, Charaxes fabius fabius, Eriboea athamas athamas, Chilasa clytia clytia* and *Chilasa clytia dissimilis,* all of which were scarce elsewhere.

Other areas visited were the low hills behind the beach between Malad and Silversands, the path from Borivili to Kanheri Caves, Powai Lake area and Vihar Lake area.

The list given below is compiled from butterflies actually taken and definitely identified, and in cases where I was in doubt as to correct identification, especially in the Lycaenidae and Hesperidae families, my specimens were identified by the authorities in the museum at Bombay. The only one in my list not taken is *Papilio polymnestor polymnestor,* but there can be no doubt over this as there is no other possible identification for such a conspicuous butterfly.

There are at least three other lycaenids in the area, but as I have not been able to obtain specimens they have not been included in my list. One of these is, I think, *Amblypodia centaurus.*

PAPILIONIDAE

1. **Polydorus aristolochiae**

Very common at all seasons. Very variable in extent of white patches on hind wings.

[My experience is that this insect is common in places only.][2]

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[1] For a map and topographical details etc. see The Birds of Bombay and Salsette by Sálim Ali and Humayun Abdulali. *Jour. B.N.H.S.*, Vol. 39, pp. 84-87.

[2] The notes within square brackets are by Mr. J. I. Alfrey, a keen student of butterflies with long experience of the Bombay neighbourhood.—EDS.

2. Polydorus hector

Uncommon. A few seen at Malad in July and August, and one at Trombay in August.

[Fairly common and of course is a great migrant.]

3. Papilio polytes

Not a common butterfly in this area though I have seen it all over Salsette, but never more than two or three in a day. One female, form *stichius*, was taken at Tulsi in August and was exceptionally large—116 mm. This was the only female seen.

[Common in places; this remark covers the 2 female forms also. These 2 forms have bred on a small lime tree on my terrace garden.]

4. Papilio polymnestor

One seen on the 6th November near Tulsi. A very difficult butterfly to catch.

[I record having seen a fine female in the garden of 'Silver End', Strand Road, obviously travelling from across the harbour.]

5. Papilio demoleus demoleus

Very common everywhere.

[Agree. This can be a terrific defoliator; I record one large lime tree that was entirely stripped of foliage by the larvae of this insect at the Cooperage and as new leaf buds appeared, females again oviposited on them and the tree eventually died. This insect is interesting and I have noted migrations at different places, the last one being at Jhansi where the insects frequented the Kitson oil lamps on the railway station at night; also came into the railway carriages where several were lacerated on coming into contact with the electric fans.]

6. Chilasa clytia clytia

Very scarce—only four seen—three on top of Trombay Hill in January and February, and one at Tulsi Lake in March.

7. Chilasa clytia dissimilis

Commoner than *clytia clytia*, but not plentiful. Taken on Trombay Hill, Vihar Lake and Tulsi Lake.

8. Graphium agamemnon menides

Common all over the area July to October; scarce in other months.

9. Graphium teredon sarpedon

Very scarce. Only three seen at Tulsi in October-November, and two at Kanheri.

10. Graphium nomius nomius

Took two good specimens at Tulsi in March; several seen on the same day. Not seen elsewhere or at any other time.

[11. **P. helenus**

I have seen them several times at Ghodbunder, but not taken any.]

PIERIDAE

1. **Leptosia nina nina**

Very common in all wooded areas.

2. **Delias eucharis**

Very common everywhere.

3. **Appias libythea libythea**

Only three seen—all males at Malad in July. No female seen.

4. **Appias albina**

One male taken at Malad in July; no others seen.

5. **Catopsilia crocale**

Very common, especially ♂♂. Very variable in size and markings.

6. **Catopsilia pomona**

Not so common as *crocale,* but quite plentiful.

7. **Catopsilia pomona var. catilla**

Not common. One female taken at Powai and others seen at Tulsi.

8. **Catopsilia pyranthe pyranthe**

Fairly common everywhere.

9. **Terias libythea**

Common everywhere.

10. **Terias venata venata**

Rather scarce. A few taken at Powai Lake in August.

11. **Terias laeta**

Not so common as *libythea,* but plentiful.

12. **Terias hecabe simulata**

Very common.

13 **Huphina nerissa phyrrne**

Very common everywhere.

14. **Ixias pyrene**

Males common everywhere; females scarcer but not rare.

15. **Ixias marianne**

Males common everywhere; females scarce.

16. Hebomoia glaucippe australis

Fairly common—particularly round Tulsi Lake. Females scarcer than males. Saw one in Marine Drive in February.

17. Colotis amata amata

A few seen at Malad in July; not seen anywhere else.

18. Colotis etrida

Fairly common in July August and again December to March.

19. Valeria valeria hippia

Males very common but females scarce. Only a few seen in August and October at Powai and Tulsi.

[20. **C. calois modesta ?**]

DANAIDAE

1. Danais limniace mutina

Very common everywhere.

2. Danais septentrionis

Only three seen and two taken—all at Tulsi Lake in October. Specimens taken with brown stains on upper hind wing.

3. Danais aglaea aglaea

Not common on Salsette. A few seen on Trombay and one taken at Powai in August.

[I can most definitely confirm that I have taken this butterfly on Salsette during the monsoon—notably at Powai Lake in August and also at Trombay.]

4. Danais plexippus

Very common everywhere.

5. Danais chrysippus

Very common everywhere. In July at Malad a number of very small specimens were taken, all measuring between 52 and 56 mm.

6. Euploea core core

Very common.

7. Euploea coreta coreta

Only seen at Tulsi in October.

There was a great swarm of *Euploeas* at Tulsi Lake in October 1949 on thistles and other flowers at the eastern edge of the lake. I caught a few and noticed that one of them had the two bands on the forewing, and later out of over 100 caught I found there were 9 *coreta*. This was noted by Mr. Alfrey when I showed him my collection, though possibly he may not remember.

SATYRIDAE

1. **Mycalesis perseus**

Common everywhere.

2. **Mycalesis mineus polydecta**

Fairly common.

3. **Lethe nohria nilgirensis**

One taken at Tulsi—the only one seen.

4. **Ypthima baldus**

Very common.

5. **Ypthima hubneri**

Fairly common.

6. **Melanitis leda ismene**

Very common.

ERYCINIDAE

Abisara echerius prunosa

Fairly common.

NYMPHALIDAE

1. **Charaxes polyena imna**

Not common but fairly plentiful on the top of Trombay Hill where I have seen as many as twelve in one day. Very difficult to catch and I have only taken two tattered males. Females very scarce. Also saw one male at Tulsi.

2. **Charaxes fabius fabius**

Not common. Have taken two on Trombay Hill and one at Ghodbunder. Not seen elsewhere.

3. **Eulipis athamas**

Not common. Several taken on Trombay Hill; also seen at Tulsi.

4. **Apatura camiba**

One male taken at Tulsi; otherwise have not seen this anywhere.

5. **Euthalia lubentine**

One seen at Tulsi.

6. **Euthalia garuda anagama**

Not common, but have seen a few at Tulsi and at Kanheri. One flew into the house in Bombay at 9 p.m. one night in October.

7. **Euthalia nais forst**

Not common but seen at Malad, Tulsi, Powai and Trombay.

8. **Limenitis procris**

Uncommon. Have seen six in all at Tulsi only: November, December, March.

9. **Pantoporia inara**

One seen at Tulsi but not identified positively—December.

10. **Neptis columella**

Only two seen and taken, both at Tulsi in November.

11. **Neptis hylas varuna**

Very common everywhere.

12. **Precis hierta hierta**

Very common everywhere.

13. **Precis lemonias vaisya**

Very common.

14. **Precis iphita pluvialis**

Very common.

15. **Precis almana almana**

Not so common as other *Precis*.

16. **Precis orithiya**

Scarce. Not more than 12 seen during 9 months' collecting.

17. **Vanessa cardui**

Very common, especially at Malad in October.

18. **Hypolimnas bolina**

Males very scarce; only three seen, two at Tulsi and one in Bombay City. Females very common.

19. **Hypolimnas misippus**

Females very scarce; only two taken in the whole period (November), both at Tulsi Lake. Males plentiful October-December, but scarce at other times.

20. **Kallima philarctus horsfieldii**

Very scarce. Took six at bottom of Trombay Hill in August including 1 pair *in copula* and saw another pair *in copula*. Seen others at the same place early October, but not since. One also seen at Tulsi in October and another in March; otherwise none.

21. **Atella phalante**

Very common everywhere.

22. **Ergolis merione taprobana**

One seen at Malad, and one taken at Tulsi.

23. **Telchinia violae**

Only four seen: two at Malad, one at Kanheri and one taken at Trombay in August.

LYCAENIDAE

1. **Jamides celeno celeno**

Common all the year round.

2. **Jamides bochus bochus**

Males common in August in wooded country; females rarer. Seen from August to February.

3. **Castalius rosimon rosimon**

Common all the year round in wooded country.

4. **Castalius deleta decidia**

Fairly common. Flies with *rosimon*, but is scarcer.

5. **Zizera trochilus putli**

Taken at Powai in August, Tulsi in September. Very common.

6. **Zizera lysimon**

A number seen at Kanheri in October and one or two at Tulsi; otherwise not common.

7. **Spindasis vulcanus vulcanus**

Not common. Two taken at Malad in July and a few seen at Tulsi. One seen on Marine Drive.

8. **Spindasis lohita lazularia**

Only two seen on the same day and one perfect specimen taken at Tulsi in March.

9. **Rapala schistacea**

One taken at Powai in August, the only one seen.

10. **Rapala melampus**

One taken at Trombay in October. No others seen.

11. **Rapala varuna lazulina**

Several seen at Kanheri in October and two taken. Others seen at Trombay in November.

12. **Catachrysops strabo**

Common everywhere.

13. Loxura atymnus atymnus

Rather scarce. I have only seen this at Vihar and Powai Lakes in August, one pair *in copula.*

14. Curetis thetis

Females very common at Malad in July and August; also at Vihar and Powai lakes. Males much scarcer; only two seen at Trombay in October and another at Tulsi in November.

15. Rathinda amor

Very scarce. Took two at Tulsi in August.

16. Amblypodia alemon

Only one seen and taken on Trombay; no others seen anywhere. I am fairly certain this is correct. It was identified by Mr. Gilbert on or about the 12th March last year, and it seems to closely resemble the description and also a specimen in the Museum.

17. Amblypodia amantes amantes

Saw a fine male at Tulsi in July, the only male seen. Saw hundreds on top of Trombay on 27th August. All appeared to be migrating, and were flying about 10 ft. high. Took one female. The same day I saw four fly across Marine Drive. All were flying south-east, both at Trombay and Marine Drive. Apart from that one day this butterfly is very scarce, and I have only taken 4 females, all at Tulsi, in February.

18. Horsfieldia anita anita

Only two seen and taken, both at the foot of Trombay in March.

19. Iraota timoleon timoleon

Only seen two at Tulsi in August of which one female was taken. Another seen in November at the same place.

20. Virachola perse ghala

One taken at Tulsi in February in very tattered condition. The only one seen.

21. Surendra biplagiata

Only one taken at Vihar Lake in August.

22. Syntarucus plinius

One taken at Kanheri in October.

23. Nacaduba viola

Several taken at Tulsi in November and December.

24. Lycaenopsis puspa

Several taken in Tulsi in August.

HESPERIDAE

1. **Hasora alexis alexis**

Fairly common at Powai in August; also seen at Malad in July.

2. **Coladenia indrana indra**

Common.

3. **Badamia exclamationis**

Very common. I observed a large number migrating in a southerly direction on 27 August at Trombay, and again on the 2nd October at Malad. I counted 130 in a period of 10 minutes at Trombay and 57 in 10 minutes at Malad, and in both cases the migration continued all the morning. They were flying at a height of about 8 ft., though some were higher.

4. **Caprona ransonetti**

Common at Powai in August. Not seen anywhere else.

5. **Suestus gremius gremius**

Only two seen, both at Powai in July.

6. **Udaspes folus**

Common at Powai, Vihar and Trombay at all seasons.

7. **Sarangesa desahara**

One only at Powai in August.

8. **Padrona dara roll**

Two taken at Malad in July.

9. **Baoris zelleri cinnara**

One at Powai in August.

10. **Baoris kumara kumara**

Two at Trombay in October.

11. **Astycus pythias bambusae**

Taken at Trombay and Tulsi in August.

12. **Taractocera c. ceramus**

Common at Trombay at all seasons. Not seen elsewhere.

13. **Calaenorrhinus ambaresa**

A few taken at Tulsi in March.

THE GENUS *VULPIA* GMEL. IN INDIA

BY

N. L. BOR

The genus *Vulpia* was created by Gmelin in Flora Badensis **1**, 8 (1806) to accommodate the species hitherto known as *Festuca myuros* Linn., on account of the structure of glumes and lemmas and the character of the single stamen. While there is not complete agreement about the status of *Vulpia* Gmel. —Hitchcock, for instance, includes all the American species under *Festuca*—there seems to be a considerable body of opinion which is prepared to accept *Vulpia* Gmelin as a perfectly good genus. The species form a very clear-cut group. They are all annuals with strict panicles of secund spikelets, with very unequal glumes and membranous lemmas and finally there is only a single stamen present in each floret. It is likely that the species are cleistogamous.

The species *Vulpia myuros* (L.) Gmel. (*Festuca myuros* Linn.) is well known in India where it is commonly found all along the Himalaya. Its range extends to Europe and North Russia and it penetrates to Australia. It is essentially an Old World grass, which has in the last fifty years been introduced into other parts of the world. It has established itself in America.

America possesses a round dozen of the species of *Vulpia*. They are all annuals with secund spikelets and the single stamen though it is reported that occasionally there are three stamens present in each floret.

Among the American species there are two which have recently come to light in the Indian flora. One of them *V. megalura* (Nutt.) Rydb., has been confused in various collections with *V. myuros* (L.) Gmel., and is very like it in appearance. It is reported from Saharanpur and from Ootacamund, the last collection being as recent as 1947. The other species *V. octoflora* (Walt.) Rydb., is quite distinctive and is not likely to be mistaken for either of the other two. It is strange therefore that the only gathering is one by Col. Wingate in the eighteen nineties, and the exact location is unknown.

V. megalura was first collected in India in Saharanpur by Col. Wingate in 1891, and it is quite possible that *V. octoflora* was collected at the same time. J. F. Duthie, who was in charge of the botanical garden at Saharanpur about that time, is known to have introduced a number of exotics in order to test their fodder value in India. The two grasses under discussion may very well be two of those tried, and of the two it seems as if *V. megalura* has become acclimatised in the colder climates. It is probably much more common in India than is realised and it should be sought for.

KEY TO THE SPECIES

Lower glume 2.5-3 mm. long; lemmas glabrous:—
  Lemmas not at all hyaline; spikelets more than 5-flowered ... *V. octoflora*.
  Lemmas hyaline on the margins; spikelets less than 5-flowered ... *V. myuros*.
Lower glume at most 1.5 mm. long;
  Lemmas furnished with long hairs on the margins ... *V. megalura*.

Vulpia octoflora (Walt.) Rydb.

Festuca octoflora Walt., Fl. Carol. 81 (1788).

F. tenella Willd., Sp. Pl. **1**, 419 (1797).

An annual grass. *Culms* 5-40 cm. tall, slender, erect, sometimes geniculate at the base, smooth and glabrous or more or less retrorsely puberulent, particularly so below, mostly 3-jointed, striate, glabrous at the nodes. *Leaf-blades* narrowly linear, involute or rarely flat, soft, erect, or ascending, 2-10 cm. long, up to 2 cm. broad, tapering to a blunt point, smooth and glabrous, or more often retrorsely puberulent on both surfaces with short soft hairs, minutely scabrid on the margins; *sheaths* glabrous or retrorsely pubescent with very short soft hairs, scarious on the margins, somewhat loose, shorter than the internodes; *ligule* 0.5 to 1 mm. long, scarious, rounded at the top.

Inflorescence a strict panicle, erect, often reduced to a raceme of spikelets, 3-12 cm. long, often secund; branches often solitary, 1-5 mm. long, erect, 3-angled, scabrid, striate, slightly expanded below the spikelet. *Spikelets* ovate or oblong in shape, 5-9 (sometimes 13) mm. long, 5-13-flowered, with florets spreading at maturity. *Lower glume* 2.5-3 mm. long, 0.5 mm. wide at the base, 1-nerved, subulate-lanceolate, almost setaceous, scabrid on the keel; *upper glume* 3-3.5 mm. long, 1 mm. wide, lanceolate, 3-nerved, acuminate, scabrid on the keel, glabrous. *Lemmas* 4-5 mm. long, 1-1.25 mm. wide, firm, rounded on the back, lanceolate, from glabrous to very scabrous, obscurely 5-nerved, attenuate into a scabrid awn 0.5 (up to 7) mm. long; *palea* lanceolate-acute, as long as the lemma, scabrid on the keel; joints of the rhachilla clavate, 0.5 mm. long, scabrid; *stamen* 1; *anther* 0.2 mm. long, caught on top of the ovary; *styles* 2; *stigmas* 2, plumose; *grain* 1.25 mm. long, terete; *hilum* linear, half the length of the grain.

India. N.W. India, *Col. G. Wingate.*

Vulpia myuros (Linn.) Gmel., Flor. Bad. **1**, 8 (1805).

Festuca myuros Linn., Sp. Pl. ed. 1, 74 (1753).

An annual grass, tufted. *Culms* slender, up to 30 cm. tall, smooth, terete, glabrous, often geniculate at the base, finally erect, leafy almost to the panicle, glabrous at the nodes. *Leaf-blades* linear in shape, flat or folded, up to 15 cm. long, 2-2.5 mm. wide, tapering gradually to an acuminate point, flaccid to rather firm, puberulous on the upper surface, otherwise glabrous, smooth; margins sometimes involute, smooth; *leaf-sheaths* rather tight below, rather loose above, clasping the stem, almost covering the internode, smooth and glabrous, striate, the lower breaking up into fibres, all carrying leaves but the leaves of the upper sheaths small, hyaline on the margins, the hyaline portions being carried up into the ligule; *ligule* a hyaline, glabrous membrane, 1.5 mm. long.

Inflorescence a spike-like panicle, erect and stiff or nodding and flexuous, often very narrow, mostly with secund spikelets, 3-25 cm. long; base enclosed in the sheath of the topmost leaf; rachis filiform, acutely triquetrous, sharply scabrid on the angles, pale or somewhat suffused with purple, glabrous, branched; branches very short, similar to the rhachis but more slender, carrying one or two spikelets, scabrid, glabrous, fascicled, binate or solitary. *Spikelets* 8-12.5 mm. long, excluding the awns, loosely 3-6-flowered, secund, seated on rather stout triquetrous pedicels. *Lower glume* reduced to a minute scale or subulate, 0.5-1.5 mm. long, nerveless or 1-nerved, smooth and glabrous. *Upper glume* 2.5-4 mm. long, acicular, subulate in profile setaceously acuminate, 1-nerved, hyaline on the margins, smooth and glabrous; *lemmas* 4-6 mm. long, linear-acute in shape when flattened, terete in the spikelet, tapering into a slender straight awn, glabrous all over and on the callus, definitely and sharply scabrid on the upper dorsal surface, 5-nerved, slightly scabrid to almost smooth on the dorsal surface below; awn 5-25 mm. long, straight or slightly curved, scabrid; *palea* shorter, 2-keeled, scabrid on keels; rhachilla joints relatively long, being of the order 1-1.5 mm. long, scabrid; *stamen* 1; *anther* 0.4-1 mm. long; *caryopsis* 3-5 mm. long.

Quite common in the Himalaya from the Balipara Frontier Tract to Kashmir. Also found in the Nilgiris, Madras.

Vulpia megalura (Nutt.) Rydb. in Bull. Torrey Bot. Club, **36**, 538 (1909).

Festuca megalura Nutt. in Jour. Acad. Phila. n.s. 1, 188 (1848).

An annual grass. *Culms* up to 60 cm. tall, slender to somewhat robust, smooth and glabrous, leafy almost to the panicle, striatulate, terete, glabrous on the nodes. *Leaf-blades* linear, long acuminate, soft to rather stiff, flat or plicate, rolled or involute, up to 20 cm. long, 1.5-3 mm. wide, puberulous on the upper surface with short, soft, white hairs, glabrous on the lower surface, scabrid along the nerves on the upper surface and also on the margins, smooth on the lower surface; *leaf-sheaths* tight or loose, the upper somewhat inflated and containing the inflorescence, markedly striate, smooth and glabrous with hyaline margins which are continuous with the ligule, often longer than the internodes; *ligule* a hyaline membrane, 0.5-1 mm. long.

Inflorescence a strict, narrow panicle, nodding or erect, with short appressed branches, bearing few spikelets which are secund, 6-25 cm. long, at the most 2 cm. broad; rhachis triangular in cross section, winged on the angles, scabrid on the wings, pale with greenish wings, glabrous, branched; branches short, angled and scabrid on the angles, inflated above just below the spikelet, fascicled, binate or solitary. *Spikelets* about 15 mm. long, without the awns, 3-6-flowered, secund. *Lower glume* 2-2.5 mm. long, subulate, acicular, 1-nerved, hyaline on the margins, smooth and glabrous or minutely scabrid, nerve green. *Upper glume* 3.5-5.5 mm. long, acicular, 1-nerved, subulate in outline, setaceously acuminate, smooth and glabrous, or slightly scabrid on the dorsal surface towards the tip. *Lemma* 6.5-7.5 mm. long, narrowly elliptic-acute, 5-nerved, the central nerve passing out into a scabrid awn 10-20 mm. long or more, coarsely scabrid on the dorsal surface especially towards the tip, furnished with white hairs on the upper half of the margins of the upper lemmas (hairs often missing from the lowest lemma): *palea* shorter, 2-keeled, coarsely scabrid on the keels; *stamen* 1; *anther* 1 mm. long: mature caryopsis not seen.

India. Saharanpur, March 1891, *Col. G. Wingate;* Pudumund, Ootacamund, 14-9-1930, *V. Narayanaswami* (no. 4325 Madras Herbarium); Ootacamund, 7,500′, 31-1-1947, *M. B. Raizada,* 21139, 'a common grass'.

A NATURALIST IN THE NORTH-WEST HIMALAYA

BY

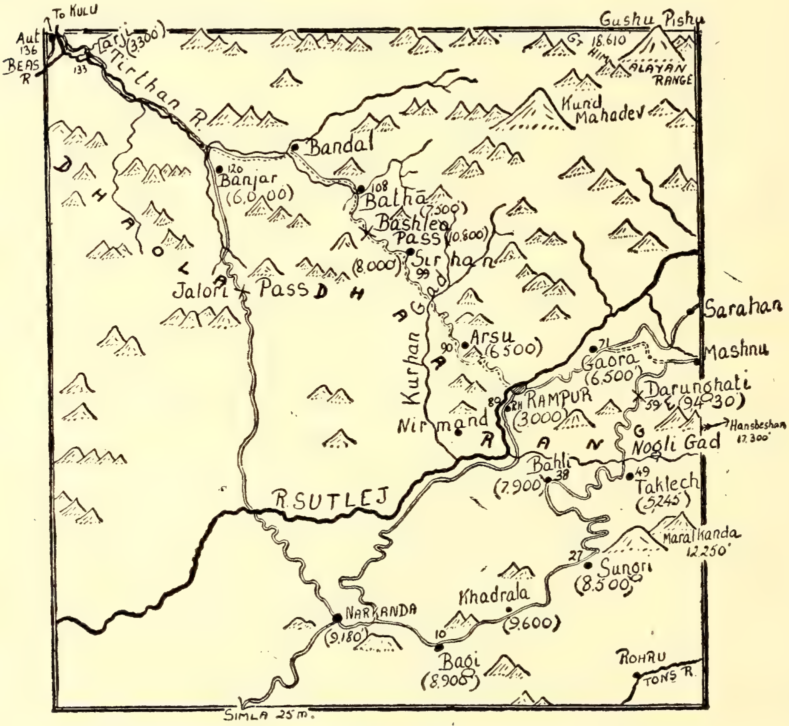
M. A. WYNTER-BLYTH

PART I

(*With a text map and two plates*)

NARKANDA TO KULU BY THE BASHLEO PASS

My original intention had been to travel as far as Charang beyond the Indian Kailas, return down the Sutlej to Rampur and then to cross into Kulu over the Bashleo Pass. Circumstances, however, were against me and I had to cut out the more ambitious part of this programme and proceed direct from Darunghati to Larji, omitting the journey into Kunawar.



Narkanda to Aut
via Darunghati

When I set out from Narkanda early on the morning of April 27th to cover the short stage to Bagi, spring had hardly touched these northern slopes of Hatu. The snows had been both heavy and late and much was still lying in the forest. Though the rhododendrons (*R. arboreum*) were scarlet with blossom there were almost no other flowers to be seen and the deciduous trees were only just beginning to burst into leaf. Bird song was noticeably absent and the forest was very silent.

Bagi bungalow, renowned in days gone by for its good fare, had fallen on evil times, for it furnished me with two of the worst meals I have ever eaten. I was glad to leave it early the next day.

The road to Sungri, running along the southern side of a long ridge, found spring much more advanced. Pale purple primulas (*P. denticulata* and *petiolaris*) were in full bloom beneath the forest trees, whilst violets (*V. patrinii* and *serpens*) and gentians (*G. argentea*) brightened the grassy roadside. The white drooping racemes of a species of *Prunus* (*P. padus*) and the scarlet of rhododendrons gave colour to the forest. Beyond Khadrala a dwarf purple iris (*I. kumaonensis?*) was massed on the hill slopes.

Some three miles from Bagi I caught a glimpse of a small red tailless object scuttling across the road, and down the side of a culvert. On looking over I saw a pika, or mouse hare (*Ochotona roylei*), staring up at me with the greatest interest (for they are the most inquisitive of creatures), an interesting find at this low altitude (9,200′)[1], as they are dwellers among the rocks of the high mountains above the tree line. Little is known of their winter habits and whether they hibernate in their alpine home or migrate to lower regions with the onset of winter is uncertain. This then was a scrap of evidence in support of the latter view.

From here until I arrived at Bahli the following day the journey was uneventful. The dak bungalow at Sungri was occupied by Lady Parmar, the Medical Director of Himachal Pradesh, who was undertaking a most strenuous official tour of the hills, and I had to make do with accommodation in a somewhat squalid subsidiary bungalow further down the hill. I was indebted, however, to Lady Parmar for an excellent dinner.

* * * * *

The chief object of my trip was to make a brief survey of game in the higher regions of Himachal Pradesh. Although I had to omit that part of my programme which would have taken me through the Great Himalayan Range, this was not a tragedy as it gave me a longer time in the Upper Kulu Valley which is inhabited by a similar fauna, only more richly. Eventually I covered a fair part of the latter area and the line of the Dhaoladhar Range from Darunghati to Larji.

This range is rich in game between the Sutlej and Hansbeshan, but further north-west, though the species are the same, it is less abundant. About the Upper Kulu Valley something will be stated later.

Here attention should be drawn to the fact that, while a stroll through a rich jungle in the Peninsula or on the plains or in the foothills of Northern India, is sure to reveal at least some of the larger game, and with luck much may be seen, this is far from the case in the high hills. In the course of a long walk through forest or a protracted scramble among the high crags and meadows above the tree line the sight of any animal whatsoever may be accounted as extremely fortunate, though game birds may be in plenty. This is partly because of the great difficulty of the terrain, partly because of the remarkable wariness of hill animals—why they are so much more timid than animals on the plains is difficult to understand as this hill country affords them great protection—and partly because of the thickness of the forests, but it is also undoubtedly due to the fact that there is much less big game on the hills than in the lower jungles. Perhaps the difficulty of survival during the severe winters is the cause of this.

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[1] In Kashmir they are commonly found at this elevation in summer.—EDS.

Among small game in that part of the Dhaoladhar visited by me pheasants are abundant, especially the Kalij (*Gennaeus hamiltoni*), known locally as the jungli murgha from its great likeness on the ground to the domestic bird. Both Koklas (*Ceriornis macrolophus*) and Cheer (*Catreus wallichii*) are also found, and the monal (*Lophophorus impejanus*) is common above 9,000′ (lower, of course, in the winter). The Black Patridge (*Francolinus francolinus*), as always, is in plenty below 8,000′ where there is cultivation, and Chukor (*Alectoris graeca*) are met with on the open hillsides, the slopes to the north of the Nogli Gad below Darunghati in particular being renowned for them. The Tragopan, or Western Horned Pheasant (*Tragopan melanocephala*), a lovely bird, is certainly very rare, if indeed it can be found at all for I could get no information about it until I arrived at Manali, where Jija Rana, the king of the pheasants, is not so very uncommon. Nor could I collect any information about that fine bird, the Snowcock (*Tetraogallus himalayensis*), but, as it is to be found above the Baspa Valley, it may well be present on the high slopes of Hansbeshan.

Of the larger game the area holds seven species: Black Bear (*Selenarctos thibetanus*) is not rare in the thick forests above 8,000′ though it descends much lower during the winter; Panther (*Panthera pardus*) is scarce but may be found as high as eight or nine thousand feet; kakkar or barking deer (*Muntiacus muntjac*), is not uncommon in jungle to 6,000′; Goral (*Nemorhaedus goral*) is fairly abundant in steep and rocky country to 7,500′; Thar (*Hemitragus jemlahicus*) inhabits forbidding crags below the snow line (those towards the upper end of the Nogli Valley near Taklech harbouring some fine heads); Musk Deer (*Moschus moschiferus*), which shares the name *kastura* with the Himalayan Whistling Thrush, is found in small numbers at high elevations, ranging as far as, and possibly beyond, Narkanda, and the Serow (*Capricornus sumatraensis*), locally called *emmoo*, a scarce animal throughout the North-west Himalaya, is occasionally met with in the thick cover of remote nalas above 7,000′.

Red Bear (*Ursus arctos*), Snow Leopard (*Uncia uncia*), Ibex (*Capra siberica*) and Bharal (*Sendois nahoor*) do not appear to be found on this side of the Sutlej any nearer than the mountains above the Baspa Valley, and, to the west, between the Great Himalayan Range and the Dhaoladhar. Beyond Sarahan, in the Sutlej Gorge, panthers are common along the trade route, preying on the flocks of sheep and goats that pass through in spring and autumn. As nian (*Ovis ammon* *hodgsoni*), the great Tibetan sheep, is mentioned in the Himachal Pradesh game licence, one assumes that this animal may occasionally be found on the Tibet border. It is certainly found no nearer.

As for the future of the game of the high hills it is pleasant, in these days when the game of India is fast vanishing from so many parts of the sub-continent, to be able to state that it seems to be in little danger from man. Indeed there is less licensed shooting than in years gone by, though this is not of necessity a good thing as such shooting keeps some sort of check on predatory species. In fact I heard it reliably voiced in Manali that the numbers of game there had decreased for this very reason.

It must not, however, be thought that I had discovered an unnatural area where poaching is unknown. Far from it! On the contrary I should say that the incidence of potential poachers is very high indeed.

One of the advantages of a non-official conducting enquiries of this nature is that he can hear much that is not for official ears. The hillmen are not reticent and I certainly found this to be so. Almost without exception they have an intense interest in sport and a very sound knowledge of the habits of local game, so who can blame them for supplementing their meagre food supplies with the occasional pheasant or kakkar in a region where the isolation of the villages and difficulty of the country make it impossible to enforce the game laws with any measure of success? My rifle and shotgun always aroused great interest and nearly always a request that we go out shooting at the earliest possible moment, irrespective of whether I had a licence, or whether what they wished me to shoot was in season or not. However, they themselves possess so few guns and so thick is the forest that what they do shoot (or trap) can really cause little harm to the general stock. These remarks, of course, refer in the main only to small game. With the big game found at high altitudes the position is different. Few of these can normally be shot without a rifle, a weapon that the hillman naturally does not possess, and in addition they are protected by the great difficulties of the country they inhabit. I am certain that the poaching of these animals is, on the whole, negligible. Musk deer, nevertheless, the killing of which is entirely prohibited, are frequently shot for the valuable musk pouch.

An interesting sidelight on the difficulties of shooting game in the high hills was provided at Pulga in the Parbati Valley, an ideal headquarters for this kind of sport. A very ancient shikari showed me his testimonials dating from the earliest years of the century. He had taken out many people, almost all of whom had seen ibex, or bharal, or red bear or tahr (except one irritated individual who wrote that he had failed to see 'any buck'), but how few had shot anything at all.

* * * *

At Bahli I spent the late afternoon in the company of the beat guard and the local bania in the exhausting and unsuccessful pursuit of kakkar. The bania, however, a keen shikari, on our return promised to get me a pheasant early next morning if I would lend him my gun. This I did, and he duly turned up with three kalij, one of which I presented to him for his trouble, threw in a couple of cartridges for luck and set out through the forest for Taklech. But I had not gone more than a mile when I was surprised to hear the sound of someone galloping after me on a pony. It was the bania. He had forgotten to collect three annas for firewood.

The weather deteriorated soon after my arrival at Taklech. As it is a pleasant sheltered place at a mere 5,000 ft. I decided to halt there over the next day to give the storm time to work itself out.

The beat guard at Taklech was an even keener shikari than his colleague at Bahli, and I allowed him to arrange a goral shoot for the morrow.

That afternoon did much to persuade me that shooting in the hills is an overrated sport!

It was already raining when we set out, and as the way at the start led through fields of standing barley I became soaking wet from the first. We then proceeded at great speed (it must be realised that I had not yet got my hill legs) up a remarkably steep and slippery path that crossed a number of nasty ledges, and awkward places where the track had been obliterated by landslides. Having climbed several thousand feet we plunged down a precipitous and treacherous hillside on which I was in imminent danger of losing my foothold and disappearing down into the Nogli Gad which appeared from this height to be a mere silver thread, until, at last, we came to rest in a narrow cleft on the face of a precipice overlooking a great sloping wall of rock across which the animals were expected to pass, it was confidently asserted, at any moment. It was still raining heavily, but, ever and anon, by way of variety, this changed to sleet. It was thundering loudly and incessantly, and some of the flashes were sufficiently close to make me seriously alarmed that our gun barrels might serve as lightning conductors. There was a bitter wind blowing from the snows and I grew colder and colder. The beat guard and his assistant, whom these vagaries of the weather appeared to leave unmoved, chattered to me cheerfully. They seemed to have a variety of grievances. But though an hour passed no goral appeared. At last, when I could no longer prevent streams of icy cold water pouring down my neck, I conveyed to them in my halting Hindi that I was returning to the bungalow to avoid frostbite. They chose to take my gun and rifle and proceed further in pursuit of the animals.

It was during my return that I hurt a toe of my left foot, an injury that made walking a painful matter for some days and brought about the change in my plans. Though I could walk uphill with a certain measure of comfort, to go downhill was extremely painful, except in my tennis shoes which eased the discomfort considerably. However, a further calamity occurred the next morning. All that night rain fell torrentially, with snow down to 8,000 ft., but dawn broke brilliantly fine though bitterly cold, so cold that I told the servant to light my fire. As I lay in bed drinking tea I thought I smelt burning rubber. Then I was sure of it, and, peering round, I saw that the left foot of my tennis shoes which had been placed in front of the fire to dry, was completely enveloped in flames.

This was serious, but, as the descent to the Nogli Gad is a short one and the rest of the way to Darunghati is all steeply uphill, I felt I could just manage it. So bidding farewell to the fine hill dog which had firmly attached himself to me, I set off. The day remained cool and very fine, and in spite of my gloomy prognostications I made short, though painful, work of the five thousand foot climb.

Notwithstanding the glorious views of the mountains, and Hansbeshan in particular, my halt at Darunghati was a miserable one. Snow was lying round the bungalow, it was unpleasantly cold and all the wood was so wet that it was impossible to make a satisfactory fire. I retired early to my 'sleeping bag'—a bedding roll, a rezai with tapes attached so that it can be tied round the body, and one or two blankets make an excellent substitute.

Just before leaving I shot a cock cheer pheasant for my evening meal and the reverberating echoes revived sad memories, for this was the triple echo at which Sheba, now, alas ! no more, had barked with such indignation four years ago.

The morning was fine and warm when I hobbled off down the hill towards Gaora, and the forest was coming to life. The grating note of the nutcracker (*Nucifraga caryocatactes*) and the plaintive and unceasing wail of the great Himalayan barbet (*Megalaima virens*) were to be heard everywhere. Both are inhabitants of the treetops and adept at keeping out of sight, the first a dark bird of the crow family with much white in the tail, and the second a large and handsome green barbet with a blue-black head. Common sounds too were the wild song of the kastura (*Myiophoneus caeruleus*), a frequenter of forest nalas and streams, whose dark plumage is transmuted to glistening blue by the magic of the sunlight, and the mellow tri-syllabic note of the Black-and-Yellow Grosbeak (*Perissospiza icteroides*), a restless bird that lives among the middle branches of the conifers and repeatedly moves from tree to tree. Once too I heard the call of the Indian Cuckoo (*Cuculus micropterus*), later on a very common sound, translated in the books by the extraordinary phrase 'kyphul pakka' ! Lower down, where the road leaves the forest, much in evidence was the clear loud whistle of the Streaked Laughing-thrush (*Trochalopteron lineatum*) and the explosive 'Tseeee-tswe' of the Brown Hill-Warbler (*Suya criniger*) as he sat on the topmost twig of some bush, ever and anon flying up to perform curious little evolutions in the sheer exuberance of living.

Just before Mashnu I turned down the Gaora link and for the first time entered country that was new to me. The road skirts the forest and there were glorious views up the Sutlej Valley of the high mountains freshly covered with snow.

Six miles out I met a young goatherd who made the surprising request that I employ him as a cook, and at nine miles I had my first quarrel with the Survey of India, the first of many. As a result of some cartographer's error I landed up at a rest house two and a half miles short of Gaora and waited there for a good hour before I learnt of my mistake. By that time the mules had by-passed me and reached their rightful destination. The map has compromised over these two bungalows by putting the symbol R.H. half way between them.

When finally I reached Gaora (not marked on the map) I found the rest house to be a bleak little building right above the Sutlej. It was, however, warm, and at last I was able to have a much needed bath.

The road from Gaora to Rampur is easily graded so the nine mile descent of 4,000 ft. was not too impossible to my poor foot. The spring movement up the valley had begun and I met repeated herds of sheep and goats carrying their little packs, ponies, donkeys and mules in the charge of a heterogeny of different peoples and races—Tibetans, Spiti wallahs, Kunawaris and others, a picturesque collection, especially the pony dealers from Spiti and Tibet. Several encampments of these were to be seen by the wayside with their neat, rather flat, streamlined tents, each ornamented with a tuft of yaks' tails, and a standard bearing fluttering prayer flags placed nearby.

Rampur, situated where the valley narrows between bare and ugly hillsides, is a squalid collection of tumbled-down houses dominated by the palace which may perhaps best be described as an elegant building in the hill style. The chief market for the trade of the Hindustan-Tibet road, Rampur is of interest as a meeting place of many races, and is famed for its pony fair in the autumn.

The rest house, a large and comfortable one, is a mile further down the Sutlej.

* * * *

The path between Rampur and Banjar over the Bashleo Pass, although seldom used, is an excellent mule track and is kept in good condition.

Having found out that the pass was open, we left Rampur early on May 5th, crossed the Sutlej and climbed into the steep valley opposite to the town. The going was hot and exhausting and we had 4,000 ft. to climb up an unshaded hillside. My young Goan servant, bearing in mind that before he made this trip he had seen no hills higher than the Western Ghats nor experienced any cold more intense than the mild Rajkot winter, had so far stood up to conditions well, but this day he was in a state of some exhaustion by the time we reached the top.

So far butterflies had been very scarce, which was not surprising in view of the bad weather, and I had seen no species of any interest at all, until half way up this hillside at 5,500 ft. I saw the handsome red-bodied swallowtail, *Polydorus philoxenus,* known as the Common Windmill from the appearance of its extended wings, beating up and down the bushes with the characteristic slow flight of its genus. Previously I had known of only one record of this butterfly from the Simla region—a strange fact, for it is common on the other side of the Bashleo Pass and also to the east of Himachal Pradesh. Some local disaster, which did not touch the species to the east and the west, has perhaps reduced the stock to vanishing point in the Simla Hills, much as I have suggested elsewhere (Vol. 48. No. 2) may account for the strange distribution of the Lepcha Bush-brown (*Mycalesis lepcha*) which is found on most of the hills of Madhya Pradesh, Orissa and Southern India but not in the Nilgiris.

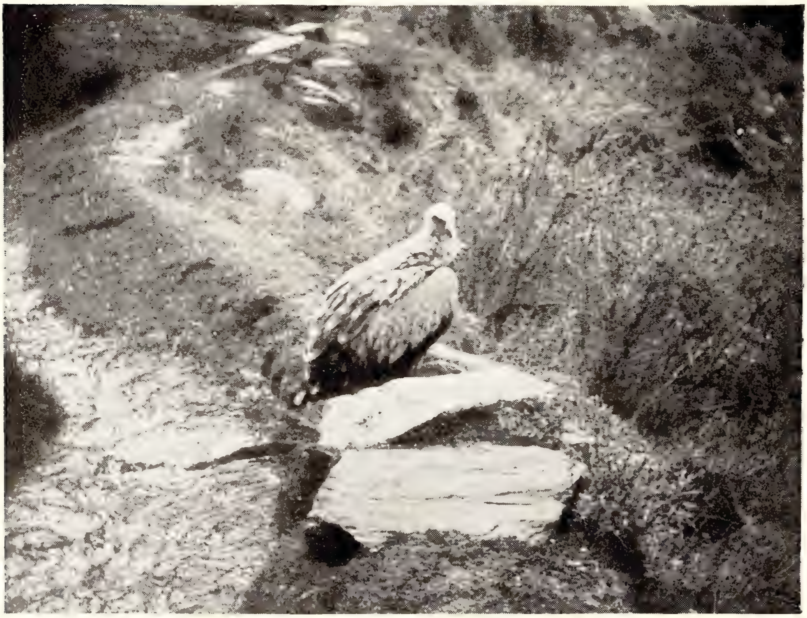
We crossed the hilltop at a little pass close to the village of Sohach, where the map places the rest house, only to find that it was another two miles further up the Kurpan Valley at Arsu. As we were told there was another bungalow at Nermand in the opposite direction, the cartographer once again seems to have adopted the expedient of making one symbol do the work of two by placing it half way between them.

Mule train crossing the Bashleo Pass.

Photos *Author*

Gushu Pishu (18,610′) (*right centre*) and Kokshane (18,940′) (*right*) from near Darunghati.

Manali—'The End of the Journey.'



Photos *Author*

Himalayan Griffon Vulture.

Nermand is famous for its *mela*, at which in days gone by, so I am told, a rope festival was celebrated. This was a kind of sacrifice to ensure the fertility of the crops. A rope was secured between a precipice and the ground at its foot so that it stretched at a steep angle, and a suitable person, a criminal or one who had seriously offended against village custom, was chosen to ride down it on a forked piece of wood the shape of a 'Y'. The top ends of the Y were placed downwards over the rope and weighted to keep them in position, while the victim clung onto the upright with his hands and to the two arms of the 'Y' with his legs. If friction caused the rope to catch on fire and he fell to the ground below and was killed he and his apparel were torn to pieces and planted in the fields. If, however, he survived, this usually only happened to his clothes.

Arsu rest house is a little one-roomed shack, and I devoted the afternoon to washing my clothes in a neighbouring stream. There was a good view of the Bashleo Pass from the verandah of the bungalow, and very forbidding it looked. I began to wonder if it would be possible to get the mules over it.

However, when I questioned Chenan Singh, my very efficient Sikh muleteer, before setting off for Sirhan the next day, he had no qualms and assured me that it would be an easy matter.

Beyond Arsu the road drops two thousand feet, gently at first, then steeply, down to the Kurpan bridge at four miles. The way led through scrub and cultivation, typical of the southern hill slopes at this altitude—standing barley and a young growth of potatoes, oaks (*Quercus incana*) badly stripped for firewood, wild apricot trees (*Prunus armenica*), roses, *Indigofera* and bushes of *Berberis*, *Rhamnus*, *Spiraea, Cotoneaster* and *Crataegus*. Beside the river-crossing an alder tree was almost hidden under a mass of the yellow spikes of *Caesalpinia sepiaria,* a scandent shrub whose limit according to Collet's 'Flora Simlensis' is only 4,000 ft. Nevertheless, as I also found it two days later beyond Bathā flourishing at 6,500 ft. it is obvious that its normal range is much higher than that.

I had heard much of the beauty of the Kulu women but it disappointed me to observe that, after leaving Rampur, the nearer I approached that fortunate valley the more ill-favoured and surly became the inhabitants. Round Arsu they belonged to a positively Simian type, and truth compels me to observe that a large proportion of the population seemed to have a mental development in keeping with their appearance. Once over the Bashleo Pass, however, there was a sudden and pleasing change for the better, both in appearance and manners.

Such local peculiarities of physiognomy are a noticeable feature of the north-west Himalaya. I remember once halting at the village of Deha in Balsan State where all the men are extremely tall and thin and have remarkably small heads and a most decided resemblance one to another, their features being quite unlike those of any others I had met in the Simla Hills or, indeed, anywhere else. Again, for example, the difference in appearance between the natives of Kulu and Manali, and those of the neighbouring Parbati Valley is most striking.

Beyond the Kurpan the track climbs steeply from woods of *Pinus longifolia* to enter the short valley leading up to the pass. A Golden Eagle (*Aquila chrysaëtos*) glided past a few yards below me, giving me the closest view I have ever had of this magnificent bird, and further up, at 7,500 ft., I saw a six-bar Swordtail butterfly (*Graphium eurous cashmiriensis*), a sign of the lateness of the season, for this extremely local *Papilio* appears with great regularity at this altitude in the Simla Hills about April 15th.

After entering the little valley the path climbs gently through pleasing scenery, mixed forest, cultivation and scrub, to give way to a steep and unpleasant ascent that winds in and out among the huge unshaded boulders of the terminal moraine of an ancient glacier that once flowed down from the head of the valley.

There was, however, ample compensation for this tedious climb, for on reaching the upper end of the moraine a scene of great beauty suddenly revealed itself. A square half mile of flat green pasture, on which grazed the tiny hill cattle, lies enclosed on three sides by huge cliffs and steep forested hillsides to form a cirque, and at the head of the pasture a stream tumbles down the crags to meander peacefully across the meadow past a little wooden temple.

When I arrived the chowkidar was absent from the bungalow, which is disappointingly placed to face away from the cirque, but an elderly crone who was minding cattle came to my rescue by emitting a series of eldritch shrieks in the direction of the village, three quarters of a mile away, which brought the chowkidar hurrying in a very short time.

The art of shouting from khudside to khudside has been highly developed in these parts, among whose simple folk it may almost be said to take the place of the telephone. I know of no place where it has been developed to a finer art than at Deha, the village mentioned a few paragraphs back, for there the inhabitants carry on conversations with the next village down the narrow funnel-shaped valley, fully two miles away. The replies float up from below, mere whispers of sound. Curiously enough this form of communication does not seem to be much in use in Kulu.

On opening one of my food boxes a scorpion was found (I think it had made the journey from Taklech where we had found another one) but otherwise the afternoon passed uneventfully and pleasantly among these delightful surroundings. Nevertheless, the pass looked even more forbidding from close quarters. It seemed to zig-zag up an almost vertical precipice.

The weather was gloomy when we set out the next morning, but, after a shower of rain, it cleared up to become brilliantly fine once more. Chenan Singh proved to be correct and the ascent of the pass was easy. Thirty-four cleverly engineered zig-zags take the road up the precipitous head of the valley. Then, at a gentler angle, it passes through a conifer belt onto meadow land and finally through a strip of mountain oak (*Quercus semecarpifolia*) to the summit.

The Bashleo, though a low pass—it is 10,800 ft.—is almost all that a pass should be, for it looks impressive from a distance, it is steep, it passes over a col between two high mountains, it is sufficiently high to be interesting, the ascent from Sirhan is not long enough to be tiring and there is a fine view back from the top, though the view towards Kulu is disappointing as it looks towards the lower hills.

On the pasture I saw my first Alpine Choughs (*Pyrrhocorax graculus*) and a Snow Pigeon (*Columba leuconota*). Of the latter more will be said presently for it is a very common bird above 10,000 ft. in Kulu. The chough is very like a small jungle crow with a short yellow beak, a character that readily distinguishes it from the other species found in the hills, though less commonly, the Red-billed Chough (*Pyrrhocorax pyrrhocorax*), whose bill is longer, curved and coral red. It is a lively bird that is much given to mild aerobatics and possesses a variety of calls that are both more shrill and musical than is usual with the crow family. This bird, too, is abundant at Manali, over 8,000 ft.

The southern face of the pass was free from snow except for one or two deep drifts, and primulas (*P. denticulata*), the first heralds of spring, were just beginning to show their heads, but no other flowers were yet to be seen and the grass was still brown from its winter sleep. The northern side of the pass, however, was snowbound, and the mules had to descend with care. I travelled rapidly, for my foot had recovered, and was soon at Bathā.

Bathā is prettily placed in the narrow valley on a small spur above the poplar-fringed Tirthan River, with forest all around. I spent the afternoon by the waterside watching the attractive bird life of a Himalayan stream. They are a cheerful lot. There was a trio of dippers (*Cinclus pallasi*), one cock and two hens, plunging now and then into the most swiftly flowing parts of the torrent to emerge yards away, shake their feathers and bob about on some rock. A pair of Plumbeous Redstarts (*Rhyacornis fuliginosus*), the female a grey little bird with a broadly white-bordered tail, very different from the deep slaty-blue, chestnut-tailed male, made brief hawking expeditions after insects or longer journeys close above the water from one stone to another. The male showed great displeasure at another of the species which had strayed into his territory, and chased him away in a determined manner. There was also a pair of Grey Wagtails (*Motacilla cinerea*) about their lawful business by the water's edge, and the high-pitched alarm note and prominent pied plumage of a Spotted Forktail (*Enicurus maculatus*) compelled attention to this striking bird. Once I saw a Paradise Flycatcher (*Tchitrea paradisi*) trailing his silver ribbons behind him, and a pair of Yellow-billed Blue Magpies (*Urocissa flavirostris*) made short flights, one following the other, from tree to tree. This beautiful bird is extremely common in Kulu, where the red-billed species (*Urocissa erythrorhyncha*), the common magpie of Simla, is not to be found. A noticeable absentee, a bird that is so much a part of Himalayan streams for most of the year, was the White-capped Redstart. They had left for their nesting grounds further into the hills.

Beside the rest house grew an apricot tree singled out for great attention by the Hill Jezabel butterfly (*Delias belladonna*) because it was infested with *Loranthus*, the foodplant of the larva. The slow, leisured flight and striking yellow and black markings of the undersides of its wings proclaim that this butterfly is protected by its unpleasant taste.

It is a curious, and perhaps significant, fact, and one to which I have never seen attention drawn, that the majority of butterflies protected in this way feed in their larval stage on foodplants that are either poisonous or belong to a family containing poisonous plants. For instance, in addition to *Delias* (the whole of which genus feeds on *Loranthus* or *Viscum*), the danaids of which the entire family is protected, feed on plants belonging to three genera *Apocynaceae*, *Asclepiadaceae* and *Urticaceae*, of which the first two families contain many poisonous plants and the third at least some—for example hemp—and nettles certainly possess irritant properties.. The large genus of the protected red-bodied swallowtails (*Polydorus*) feeds on the often poisonous *Aristolochiaceae*, and *Pareba vesta* on *Buddleia* of the Loganiaceae, the family that contains *Strychnos nux-vomica*. In some cases, of course, the foodplants belong, as far as is known, to families which possess no species with toxic properties (such as *Aporia*, the blackveined whites, feeding on species of *Berberis*), but these are very much in the minority. Consequently I feel that there are grounds for suspicion that protection may not always be a mere matter of unpleasant taste, but that some butterflies may absorb the properties of the plants they feed upon and be actually poisonous.

Here then, surely, is an interesting avenue of research for the bio-chemist?

The bania at Bathā was most attentive, and, having sold me eggs at a price that was hardly anything above the market rate, presented me with milk and two doves for my dinner. I wondered what was afoot, but all he wanted was a certificate from me to say what a fine fellow he was. This I willingly gave him and everybody was satisfied; indeed, he was so pleased that he courteously accompanied me for a mile upon my way.

The twenty-two miles from Bathā to Larji was very easy going, a pleasant relief from the arduous up and down of my journey since I had left Bahli.

The valley for the first few miles below Bathā is attractive, and bird and butterfly life was in abundance, *Polydorus philoxenus*, in particular, being common, but after that, as we descended, it progressively became hotter and the scenery more barren and dull.

I remember little of these two stages except that I was thirsty and warm when I arrived at the comfortable and finely situated bungalow at Banjar, and hot and very thirsty when I reached the fly-stricken civil rest house at Larji.

A three mile walk up the Larji Gorge early on the morning of the 11th took me to Aut on the main Kulu road where I said goodbye to Chenan Singh and his mules, both of which had given me the best of service, and boarded a bus for Manali.

(To be continued)

SOME BIRDS SEEN ON THE GANDAK-KOSI WATERSHED IN MARCH, 1951

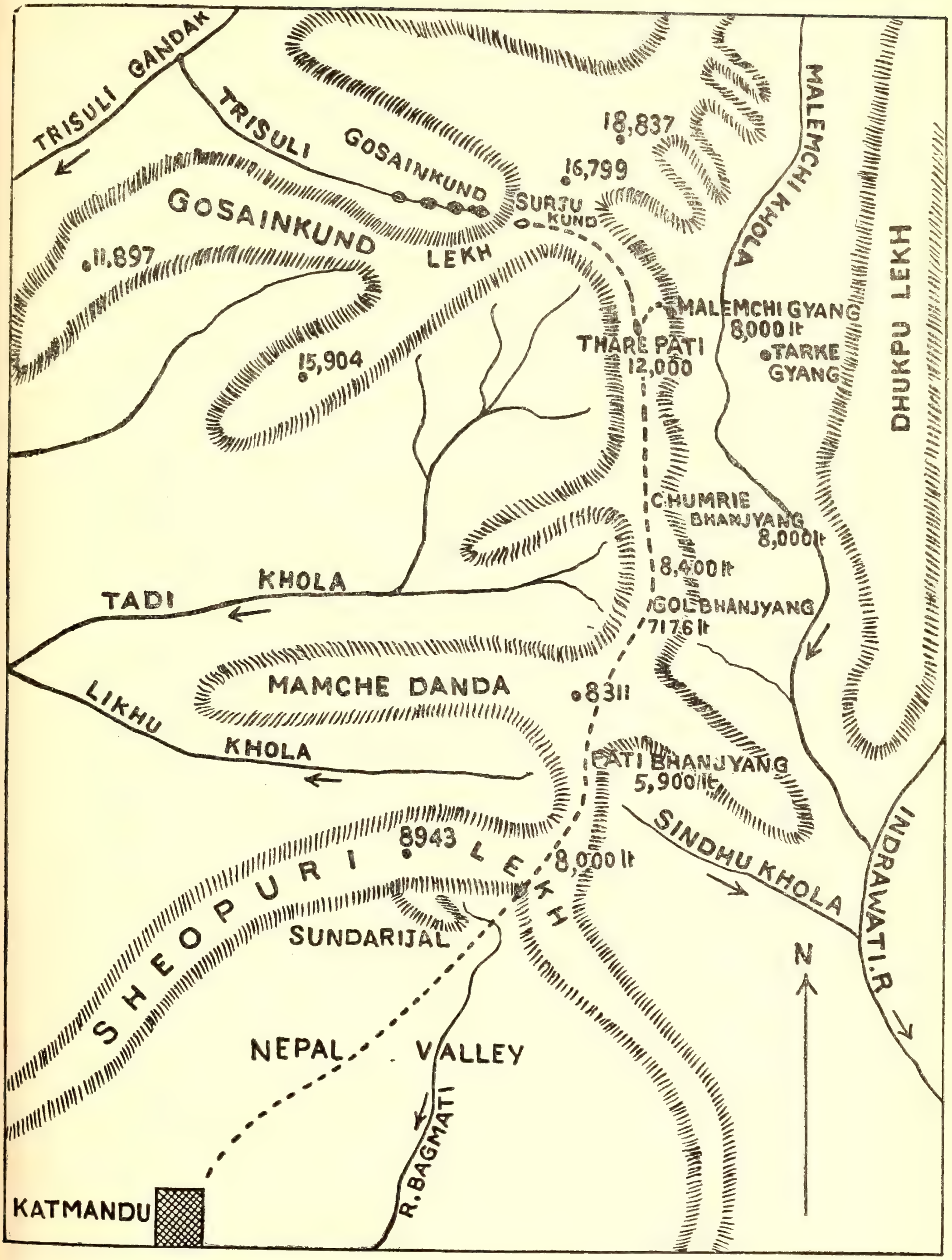
BY

DESIRÉE PROUD

(With a sketch map and a plate)

Ever since reading in the *Journal* of April 1948 (Vol. 47, pp. 432-443) Mr. Smythies's account of his journey along the Gandak-Kosi watershed, I have longed to visit the mountains he describes so well. During our first year in Nepal it was, however, impossible as I could not leave my 3 children alone in Kathmandu. This winter it seemed more hopeful, the children being safely established in England at school and with their grandmother. Incidentally, what words of praise are sufficient for to-day's grandmothers, who, in spite of rations, queues and servantless homes still open their arms to (frequently) spoilt and temperamental grandchildren from abroad? Unfortunately the winter of 1950-1951 was full of unexpected political activity. The tranquil backwater of Nepal became suddenly full of activity and it was not till March that leave became at all possible. At Easter we were given 8 days leave, during which I hoped we might reach the sacred lakes of Gosainkund and perhaps catch a glimpse of those thrilling birds, the great Parrotbill and the Beautiful Rosefinch. These hopes were all doomed to disappointment, but nevertheless the 8 days were the most delightful I have ever spent. As our trip was at a different season to that of Mr. Smythies, with conditions as different as possible, and consequently different birds, the following notes may be of some interest. We left on March 20. The winter had been an unusually dry one, with no rain for months, but the weather broke on the day we left and rain threatened as we walked up the hill past Sundarijal (5,000 ft.). The steep cultivated land beyond the reservoir was yellow with flowering *Berberis* and *Hypericum,* and wild pear was still in flower above the village. The forest starts at 6,500 ft. and a pleasant easy walk along the Sheopuri ridge follows. A tree (*Symplocos sumantia*?) was in flower all along the ridge and very attractive, the numerous stamens giving a powder puff appearance to the flowers, some yellow, some white. We had intended to have our first camp near Pati Bhanjyang, but the ominous storm clouds decided us to camp as soon as possible. Accordingly we stopped just short of the crest of the ridge, and a lovely camp site it was. The coolies went on to a little hamlet just over the ridge. We were in none too soon, for the rain came down in torrents and continued most of the night. Next morning we woke to a perfect day: Grey-winged Blackbirds singing gloriously and the whole forest sparkling in the sunshine, the dust of months swept away by the rain. A large magnolia (or *Michelia*) tree near our camp was covered with huge waxy cream-coloured flowers. These attracted numbers of birds, chiefly Striated Green Bulbuls (*Alcurus striatus*). They are very local round here and will be extremely common in one place for some weeks and then disappear, not to be seen in that area again perhaps for years. They have much sweeter notes than any other bulbul I know. The Collared Ixulus (*I. flavicollis*) also very common, and of course numbers of Red-headed and Green-backed Tits. We left at 9 and the view from the ridge (8,000 ft.) of the snow mountains was superb. The path down to Pati Bhanjyang is very steep, and as one scrambles down one looks straight across at the even steeper climb up the hills opposite and bitterly regrets the loss of height to be painfully made up later in the day. Dark-grey Bushchats and a very pale stonechat were seen here and not again. The leafless *Berberis* had very much the appearance of hawthorn bushes in England. A bush (*Edgeworthia gardneri?*) was common and in flower. It has a sweet distinctive perfume. We call it the 'buttered-egg' plant. Pati Bhanjyang is 5,900 ft. according to our altimeter, though 5,000 ft. on the map. The little town is dirty but very picturesque in a squalid way, and is obviously a dearly loved halt for the coolies. As four tracks meet here there is probably a cheap market. We foolishly went on without seeing the coolies safely beyond its fleshpots and they were very late in catching us up. Red-rumped Swallows and Himalayan Swiftlets were hawking back and forth across the pass. From the town the path at first traverses an attractive hill-side cultivated in terraces; the barley here was fine and well grown. Indian corn had just been planted and the first green spears were showing above ground. Wild cherry, plum and pear grew in the gullies and the yellow flowers of *Hypericum* everywhere. I heard the Hill Warbler (*Suya*), but did not see one. The Streaked Laughing-thrush is also often heard here. Soon the path starts to climb steeply, up and up through scrub, mostly *Gaultheria*, now in bloom with stiff sprays of waxy white flowers. *Ageratum* is a weed all over this hill. At 7,000 ft. we reached a ridge where a large and very dirty Tamang village sprawls for over a quarter mile along a very narrow ridge. This was the only place where kites were seen. The forest (oak) which had covered this ridge had been recently killed. The oaks, barked, lopped and dead stand like stiff black skeletons, and the ground beneath them has been made up into fresh fields with their leaves and branches buried in them. No doubt very rich for one or two crops, but so steep is the land that I doubt if it will hold for two monsoons and then the old fields which must have been protected by the trees will surely be swept down the precipitous slopes, and the ridge will be abandoned to thin scrub and ageratum.

At the end of the village the track again climbs steeply through piles of stones and boulders. At the top we came to another ridge, but this time covered with oak and rhododendron forest. Here we found the first Buddhist chorten and sat down for a rest and a chat with some Sherpas down from the high hills. They told us the snow was thigh deep at Thare Pati and no hope at all of reaching the sacred lakes. As there was no sign of the coolies, we decided we had better camp here and we found a lovely grassy meadow at the highest point of this ridge (8,000 ft.). Bushes of *Edgeworthia* and *Pieris formosa* in flower all round the camp and we had a superb view of snow mountains all along the east—Jugal Himal and on and on as far as Gauri Shankar. Much more exciting to us were the



ROUGH SKETCH OF KOSI-GANDAK WATERSHED

Scale: 1 inch = 4 miles

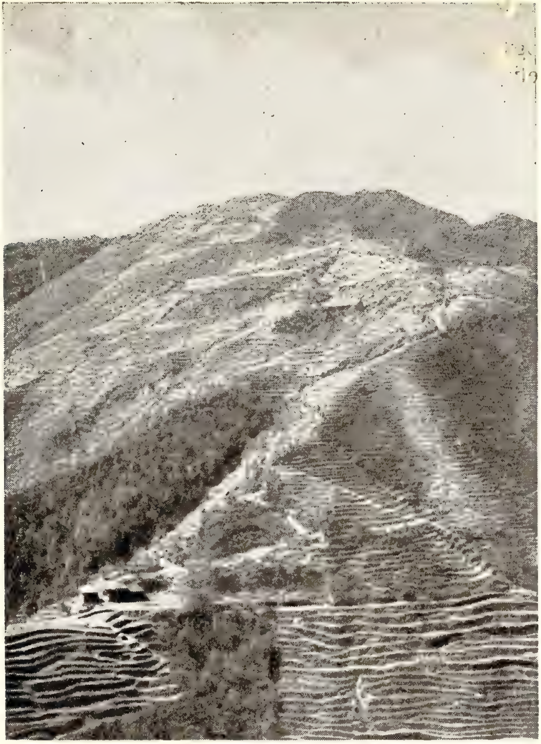
snows of the Gosainkund Lekh to the north. We were able to dry our tents etc. in the sun when the coolies finally arrived. We went to bed as soon as the sun sank, and fell asleep to the 'jug jugging' of the Jungle Nightjar.

We awoke next day to mist and cloud. A very green pipit was singing away from the top of an oak; it would sing while perched, but often soared a short distance into the air and then volplaned down singing all the time—*Anthus hodgsoni* I presume, but certainly not the race which winters in enormous numbers in the Nepal valley. Large flocks of what at first I thought were finches or buntings were ranging round the hill-sides. We saw these flocks, varying I should judge from about 50 to 400 birds, all the way from this camp up to 12,000 ft. My husband finally shot one which proved to be *Laiscopus himalayanus,* the Altai Hedge-sparrow. A pair of Chestnut-bellied Rock-thrushes were calling to each other with curious deep croaks—the male sat on top of a tree fanning his tail with each croak. Black Bulbuls were abundant but they were not seen beyond this point. Here the Verditer Flycatchers had already arrived, although I had not yet seen one down in the valley. They were paired and singing beautifully. They were not seen above 9,000 ft. Everywhere the whirring song of *Phylloscopus pulcher* was heard. The song is exactly like that of the English wood-warbler which always sounds to me like a watch spring being wound up and then allowed to run down. This whirring sound was heard all day in every patch of scrub or forest right up to 11,500 ft. I have also heard a gentle little warble which I believe is uttered by this bird, although I am not quite sure. If so, it would be an interesting parallel with the wood-warbler which also has a second song.

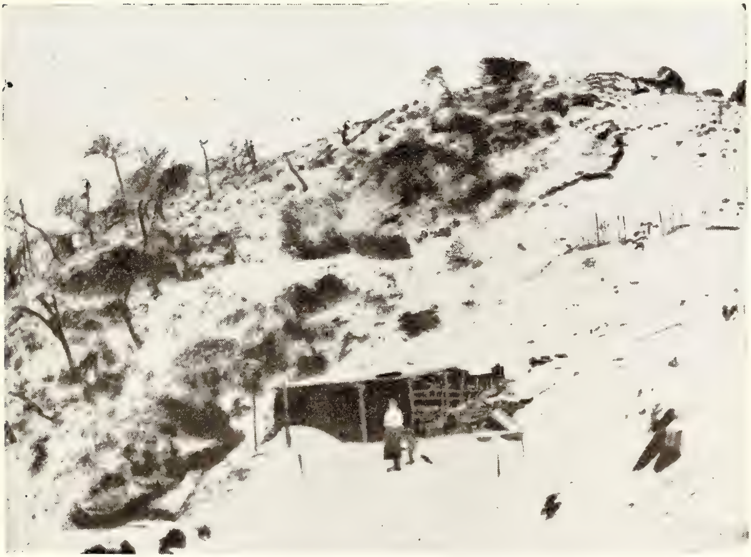
We left camp at 9 o'clock and descended a thousand feet through open scrub jungle where scattered rhododendrons blazed rosy and crimson, and the young bronze leaves of *Viburnum* and *Pieris ovalifolia* were opening everywhere—the latter a very beautiful tree with its curious spiral bark. There were also fields with well grown barley and wheat crops. We passed a little village on a pass known as Gol Bhanjyang, 7,100 ft., (here the map and our altimeter were for once in agreement) surrounded with hedges of *Edgworthia,* its curious perfume filling the air. This was the last of the Tamang villages. From here onwards Sherpas took their place with chamries (half yak) instead of the little hill cattle. Sherpa villages were noticeably cleaner than the Tamang ones. From Gol Bhanjyang the path goes up a villainous steep hill, but the country was very beautiful and ringing with bird song. We reached the top (8,400 ft.) and turning a corner, entered an enchanted world—a rhododendron forest in full bloom. I have seen many feasts of flowers—narcissus in the Alps, anemones in Kashmir, bluebell woods in England, *Strobilanthes* in the Nilgiris—but never anything so wonderful as this. Some of the trees must have been over 40 ft. high and covered from top to bottom with flowers of every shade from crimson through rosy to palest powder-puff pink and, loveliest of all, pure white, so that some trees appeared as if wreathed in snow. The whole forest echoed with bird song—Nepal Sunbirds, Hoary Barwings Red-headed Bulfinches, Stripe throated Sivas, Stripe-throated and Collared Yuhinas, Red-headed and

Green-backed Tits, Himalayan Nuthatches and tree creepers. The exquisite jewel-like sunbirds flashing in and out of the flowers were a wonderful sight. I saw a male White-browed Rosefinch the only high level rosefinch seen on the whole trip. Clumps of *Mahonia*, not in flower grew in the forest and there was also a curious pink prickly creeper in bloom. We lingered enchanted, and I was quite ready to remain here for the entire 8 days, but my husband who hates a programme to be upset, insisted on going on. Unwillingly I left this paradise and descended to the last Bhanjyang known locally as Chamrie Bhanjyang (8,000 ft.). Here we passed the coolies eating their midday lunch which seemed to consist entirely of spring onions. From here we climbed through tragically lopped oaks, many dead standing like black scare-crows. (How long can a tree stand this continual lopping?) At about 8,800 ft. we emerged from the lopped forest on to a steep hill-side splashed with flowering rhododendrons, and at this height there were no more crimson flowers, all were pale pink or white. A thick forest of unlopped oak covered the hill above us. A local Sherpa said there was no water above this place for some miles so we decided to camp. It was difficult to find a flat enough place to pitch our camp, but we finally succeeded though our beds were tilted to a somewhat uncomfortable angle. When the sun set it was bitterly cold here at 9,000 ft. and we were glad of our down sleeping bags.

We woke next morning to a perfect day. Grey-winged blackbirds singing divinely; green pipits [Hodgson's] here also singing away. We heard the cheery notes of the Yellow-billed Magpies; though similar in pattern to the Red-billed, they are much sweeter and quite distinctive. We watched a flock of them following each other across the hill-side. A buzzard flew down into a tall tree and sat contemplating the world. Green-backed tits were common, but not seen above this camp, and there were no more Red-headed tits, their place being taken by the white headed *Aēgithaliscus ioschistos*, so-named Rufous-fronted Tit, which were common here and up to 11,500 ft. *Siva strigula* common here, but not seen any higher. I heard a woodpecker drumming away and presently found it working at a nest hole about 20 ft. from the ground. I was very surprised to find it was *Dryobates macei* which I have always looked upon as a low level bird in Nepal. A Lämmergeier sailed superbly overhead and a very pale kestrel poised on quivering wings in front of the camp. We left at 9 and climbed straight up the hill through a dense forest of oak (*Quercus semecarpifolia*). For the first time one could see what magnificent trees they are when allowed to grow naturally without lopping. A few tree rhododendrons, mostly white, glowed through the dark forest. At 10,000 ft. we came out of the oaks and above this there were no more tree rhododendrons. We walked up an open grass lane about 20 yards cut through a dense forest of *Rhododendron falconeri*, the flowers all shades of very pale pink and cream spotted inside with purple. Their flowering season must be a very short one, as on many trees half the flowers had faded whilst others were still in bud. They are therefore much less beautiful than *R. arboreum*, although the dark drooping leaves with the thick rusty fluff underneath are very attractive. The grass was covered with tiny blue gentians and a



Path running down to Pati Bhanjyang showing terraced cultivation.



Photos *Author*

Sherpa hut at 11,000 feet.

yellow hawkbit with stems so short that they appeared like golden stars on the grass. At 10,500 ft. we reached the top of the climb and the path wound round the side of the hill and then along a ridge. *R. falconeri* was everywhere, but at this height in bud only; there were also thickets of *R. barbatum* with warm pink bark and long drooping leaves of a very clear pale green both above and below. They were all in flower even up to 11,500 ft., the dark red flowers rather disappointing. The north slopes of the hills here were deep in snow and the effect of the warm pink stems against the coldness of blue-white snow shadows was startling and very beautiful indeed. Another rhododendron, *R. campanulatum*, was common, but its tight buds showed no signs of opening and I could not tell what colour they were likely to be. Silver firs began to appear, and junipers. The ground in damp places and the mossy banks were covered with a beautiful primula, like a primrose in size and habit but pink or pale mauve in colour (*P. petiolaris?*) Berberis grew in all the open places and seemed to be of 2 kinds: one a bush, hawthorn-like in appearance quite leafless, the withered crumpled red berries still hanging on the bare usually white stems; the other grew only 18 inches high. The stems were red and the bright red leaves were still adhering to the branches. It covered large patches and in the distance gave a warm glow to the otherwise rather cold grey landscape. I do not know if they are different species or merely varieties of *B. vulgaris*. Both plants have the usual 3 pronged spines. We heard the nutcracker here and saw a number of crested tits, and these I am sure were *Lophophanes melanolophus*, although I discovered on my return that these are not supposed to be found east of Garhwal. The row of white spots on the wing coverts was most distinct, and the bird was iron grey below with no touch of rufous. The nape patch appeared pure white. I am certain it was not *L. ater*, a bird I have seen in the high hills round the Nepal valley, but not met with on this trip.

The path wound along the ridge rising gently and dipping through exquisite valleys where deserted Sherpa huts stood on grassy margs and little streams bubbled through mossy banks starred with primulas. The ridge grew narrower and above 11,000 ft. there were no more flowers. Juniper scrub gave a rather sad grey-green look to the landscape. Soon the snow became so thick that it seemed cruel to take the barefooted coolies any further, so we left them to pitch camp near a little chorten where there were empty huts for them, and we went on ourselves to Tharepati. The ridge here is unbelievably narrow, the top being only about 15 ft. wide with great precipices each side running down to the Malemchi Khola on the east and to the Tadi Khola on the west. Across the Malemchi Khola we could see a tiny path running sheer up the opposite mountain side. This presumably was the path Mr. Smythies took on his way to the Ganja La. The snow was quite unbroken by any human feet, but covered with tracks of mousehares, gooral or thar and the curious splayed footprints of musk deer. Tracks of monal were everwhere and we kept running into little parties of these magnificent birds, usually a cock and 2 or 3 hens. They were astonishingly tame. The top of the ridge is just over 12,000 ft. (it runs gently down and widens out at Tharepati). In the bright sunshine the white world was infinitely beautiful, the great white-splashed cliffs of the Gosainkund Lekh so thrillingly near to us now. But alas for the sacred lakes, the path was deep in snow and obviously impossible. I should imagine late May or June would be the time to do it before the leeches appear to spoil the pleasure. Returned to our camp, melted snow for drinking, and so to bed.

We woke next day to a grey sky. Choughs were calling and I watched a pair of Black-faced Laughing-thrushes creeping through the juniper scrub. Jungle Crows were all round the camp which evidently intrigued them as at least a dozen were collected full of curiosity. Every now and then they would all fly up suddenly and wheel backwards and forewards across the ridge, using the air currents and obviously enjoying their skill and complete mastery of the air. They have a deep bell-like note almost like a raven. While we had breakfast it began to snow, tiny white flakes blotting out the landscape. We had hoped to spend two days here, but no birdwatching could be done in this weather and as there was no hope at all of reaching the lakes we decided to move down to one of the more open margs. As I was packing, my husband shouted 'Hurry up here are flocks of your parrotbills', I rushed out and the junipers were full of birds—alas not parrotbills, but White-winged Grosbeaks. We found them very common up to 12,000 ft. in the junipers. They have a very distinctive double whistle, rather harsh but pleasing. During the morning we moved down to an open marg where there were four huts for shelter if needed, as our tent was certainly not snowproof. This was really our loveliest camp at a height of 11,000 ft. and we remained here three nights. The surrounding rhododendron and juniper forest swarmed with birds. Fulvettas were very common, also crested tits of three kinds, Yuhinas of three kinds, Variegated Laughing-thrushes and Nepal Wrens. Some migrants had already arrived. Blue-fronted Redstarts were common, already paired. I saw a female carrying nesting material into the crevices between logs forming the wall of a Sherpa hut. Although already nestbuilding at this height, these birds were still common in the Nepal Valley on our return, and remained so until first week of April. Red-flanked Bush-robins were also common here and these had certainly vanished from the Valley some time before. I saw an Orange-gorgetted Flycatcher uttering a curious note, never heard in the Valley so presumably a breeding call. Buntings were common, but I failed to identify them. They had a little rattling song which reminded me of the song of *E. stewarti*. The Chestnut-naped Yuhina also had a delightful little song, uttered in the evenings from the top of a bush. The turf here was as springy and kind to the feet as the turf of a Scottish moor. Apart from the primulas there were no flowers yet, but the promise of them everywhere in tiny rosettes of leaves. Amongst others, plants like tiny houseleeks not half an inch across.

The silver firs have been terribly thinned by cutting and burning, and what is so sad to see is the terrible waste of timber. Magnificent trees were lying with the wood rotting, only about a quarter of the tree having been used. However, the silver firs seem to be regenerating naturally, for although almost no full grown trees were seen, there were whole forests of young trees growing well and looking very healthy.

It is a much less happy case with the oaks at between 8,000 and 10,000 ft. for they will surely be destroyed altogether if nothing is done to control their lopping for fodder. I have only been used to the Alpine forests of the Western Himalayas and find the dense thickets of bamboo (now leafless), the moss and lichen festooning all the trees a curious background for fir and juniper and falling snow. We noticed that there is never any moss or lichen on the pink stems of *R. barbatum*. Is this because of the continuously peeling bark? The weather got steadily worse and on the last night we had to abandon our tent and take refuge in a Sherpa hut. The coolies tell us that the Sherpas bring their animals up here in June and stay till October. We had meant to spend the last day collecting birds, especially buntings, but the weather was too bad. It was with great reluctance that we left this wonderful Alpine world. We did the return journey in two days spending one night at the site of our second camp. We saw large swarms of migrating phylloscopi where there had been none except *P. pulcher* on the upward march. Many *P. affinis,* the only ones I could recognise for certain. On the ridge above Pati Bhanjyang we saw large flocks of Common Rosefinches and Himalayan Greenfinches, neither of which we had seen on the upward trip. I was much struck by the cheerfulness of the coolies who were always merry and full of jokes, even when conditions were very cold, which with their thin clothes and lack of shoes must have been most unpleasant for them. It was with the greatest regret that we returned to the Valley on March 27, and the dullness of everyday life. We are most grateful to H. H. the Maharajah for making our trip possible. Since writing the above, Mlle Ella Maillart has done the above journey, and reached the sacred lakes on May 8. She said the snow was still very deep north of the pass, although quite clear on the south side. She thinks it unlikely that the journey could be done before the end of April. She said that a mauve rhododendron (*R. campanulatum*?) was in flower at 11,500 ft. and above, but that otherwise there were still very few flowers.

LIST OF BIRDS SEEN ON THE GANDAK-KOSI WATERSHED

Corvus macrorhynchos : Jungle Crow.

Common on ridge at 11,000-12,000 ft.

Urocissa flavirostris : Yellow-billed Blue Magpie.

Seen below thick oak forest at 9,000 ft.

Nutcrackers and choughs were heard above 10,000 ft. but not seen.

Lophophanes melanolophus ? : Crested Black Tit.

Very common indeed in the juniper and rhododendron forest 10,000-12,000 ft. I had a very good close view and there was no rufous on the breast or abdomen. I see that Stuart Baker says it is not found east of Garhwal and would be interested to know if this is so. It has a thin 'zee zee' note, also a double note 'chee wee' very bell-like and ringing. I saw one pair carrying nesting material.

Lophophanes rubidiventris: Rufous-bellied Crested Tit.

Also very common in the same area as last species. Note a cheerful 'chee-er chee-er chee-er', also single call note. Like Mr. Smythies I noticed a grey patch between the rufous on the breast.

Lophophanes dichrous: Brown Crested Tit.

Seen in the same area as the above, but much the scarcest of the three. Very like a yuhina in appearance. I did not hear it utter any note.

Aegithaliscus ioschistos: Rufous-fronted Tit.

Common in small parties from 9,000 ft. up to 12,000 ft.

Sitta himalayensis: White-tailed Nuthatch.

Common along ridge up to 9,500 ft.

Garrulax albogularis: White-throated Laughing-thrush.

A large party seen on the ridge near Chamrie Bhanjyang at 8,400 ft.

Trochalopteron affine: Black-faced Laughing-thrush.

A pair, very silent, creeping about in the juniper scrub near our camp at 11,500 ft.

Trochalopteron variegatum: Variegated Laughing-thrush.

The common laughing-thrush at 11,000 ft. They were always in small parties, uttering low conversational notes all the time.

Trochalopteron lineatum: Streaked Laughing-thrush.

Heard round Pati Bhanjyang and on the ridge at 8,000 ft.

Fulvetta vinipecta: Hodgson's Fulvetta.

Very common round the camp at 11,000 ft. and down to 9,500 ft., usually in large mixed flocks with tits and yuhinas. Has a high pitched chirping note and also a sweet gentle little song.

Ixops nipalensis: The Hoary Bar-wing.

Common in the rhododendron forest 8,000-9,000 ft., one bird seen at 11,000 ft. Some of its notes are very like those of the Streaked Laughing-thrush.

Yuhina gularis: Stripe-throated Yuhina.

Common in large flocks all the way from Sheopuri 8,000 ft. up to 11,000 ft., usually in mixed flocks never away from the forest. Has a very curious and characteristic call, a long drawn out 'kweeeee' very far-carrying.

Yuhina occipitalis: Chestnut-naped Yuhina.

Very common round our camp at 11,000 ft. In the evening they would utter a gay little song while swinging on the top of a bush.

They have also a deep churring note with which the flock keeps in touch when feeding.

Ixulus flavicollis : Yellow-collared Ixulus.

Common from 8,000-9,000 ft., a few seen up to 10,000 ft. Has loud double chirp, also querulous 'screech screech' followed by pleasant warble.

Leioptila capistrata : Black-headed Sibia.

Abundant 8,000-9,000 ft., but not higher.

Siva strigula : Stripe-throated Siva.

Very common all along the ridge at about 8,000 ft., not seen above 9,000 ft.

Liothrix lutea : Red-billed Liothrix.

A few seen on ridge at 8,000 ft.

Certhia familiaris: Nepal Tree-creeper.

Common from 8,000 ft. up to 11,500 ft., constantly uttering a cheerful little trill.

Troglodytes troglodytes: The Wren.

Common from 10,000 ft. up to 11,500 ft. We were constantly disturbing them out of fallen tree trunks, piles of boulders, etc. They would fly off uttering a little scolding note, then bob and scold on some vantage point before dashing again into cover. No song heard.

Phoenicurus frontalis: Blue-fronted Redstart.

Common all the way up to 11,000 ft. At latter height they were paired, and 1 pair was nestbuilding.

White-capped Redstarts and Plumbeous Redstarts were not seen. The former were still common at Sundarijal at 5,000 ft. and evidently had not begun their upward migration.

Ianthia cyanura : Red-flanked Bush-Robin.

Common in pairs up to 11,500 ft. in rhododendron forest. Both sexes utter a deep 'tok' note. No song heard.

Turdus boulboul : Grey-winged Blackbird.

Common up to 9,000 ft. in forest. Very beautiful song in the early mornings.

Oreocincla dauma : Mountain Thrush.

One seen at 8,500 ft. March 26.

Monticola erythrogastra: Chestnut-bellied Rock Thrush.

A pair at 8,000 ft. in oak forest. Not seen again.

Myiophoneus temminckii : Himalayan Whistling-thrush.

On all streams up to 11,500 ft. No song heard above 8,000 ft., but below that height in full song.

Laiscopus himalayanus : Altai Hedge-Sparrow.

Seen in very large flocks all the way from 8,000-11,500 ft. They have very sweet notes when on the wing. Until my husband shot one I had imagined they were finches or buntings. Some of the flocks must have contained quite 400 birds.

Siphia strophiata ; Orange-gorgetted Flycatcher.

One seen at 11,400 ft., a male. It was uttering a triple note 'Tin-ti-ti'. The first syllable metallic and far-carrying the two others soft and only audible a few yards so that at a distance it sounds like a single ringing note; I have never heard this in the winter so suppose it is a breeding call.

Eumiyas thalassina : Verditer Flycatcher.

Common in pairs up to 8,500 ft. and singing beautifully.

Phylloscopus pulcher : Orange-barred Willow Warbler.

Very common from 8,000 ft. up to 11,500 ft. The whirring song heard all day in every patch of forest. They are abundant on the hill-tops round the Nepal Valley until mid-April when none are left even at 9,000 ft.

Phylloscopus affinis : Tickell's Willow Warbler.

Numbers seen on passage at 8,000-9,000 ft. March 25-26. None seen before this date.

Large numbers of unidentified Phylloscopi were seen on migration. *P. proregulus*, so common during the winter all over the Valley, was not seen anywhere.

Seicercus xanthoschistos : Grey-headed Flycatcher-Warbler.

Abundant up to 8,500 ft.

Perissospiza carneipes : White-winged Grosbeak.

Very common in the juniper forest 10, 500-12,000 ft., always in large flocks and very noisy.

Pyrrhula erythrocephalus : Red-headed Bullfinch.

Several seen at 8,000-9,000 ft. in flowering rhododendrons.

Propasser thura : White-browed Rosefinch.

A single male seen in rhododendron forest at 8,400 ft.

Carpodacus erythrinus : Common Rosefinch.

A large flock met with on the return journey on the ridge north of Pati Bhanjyang at 8,000 ft.

Hypacanthis spinoides: Himalayan Greenfinch.

A flock seen above Pati Bhanjyang at 7,000 ft. on return journey.

Anthus hodgsoni: Tree-pipit.

A very green tree-pipit singing and paired seen at 8,000-9,000 ft. I should think it was on its breeding ground. It was very much greener than the bird which winters in very large numbers in the Nepal Valley. The latter are very late in leaving the Valley being the last migrants to disappear. This year they were common in the Valley itself until 12 April and on the surrounding hills at 7,000 ft. upwards for 10 days after leaving the valley. Does this very green bird breeding at 8,000-9,000 ft. perhaps remain in its breeding haunts all winter?

Aethopyga nipalensis: Nepal Sunbird.

Common in rhododendron forest 8,000-9,000 ft.

Cynnyris asiatica: Purple Sunbird.

I saw a male in full breeding plumage at Pati Bhanjyang 5,900 ft. They are never seen in the Nepal Valley until July when the males are either in eclipse dress or moult soon after arrival. I was therefore interested to see this one at some 500 ft. above the level of the Valley and probably breeding. Pati Bhanjyang though higher than the Valley is the watershed for two streams the Likhu Khola and the Sindhu Khola which both run down within a few miles to 2,000 ft. To reach the Nepal Valley the birds would have to cross hills of 6,000 ft. or more, and this I suppose deters them from breeding in the Valley where I should have thought conditions were most suitable.

Collocalia brevirostris: Himalayan Swiftlet.

Several seen hawking across Pati Bhanjyang and Gol Bhanjyang.

Dryobates macei: Fulvous-breasted Pied Woodpecker.

I was very surprised to see this bird at 9,000 ft. as I had always thought of it as not found above 7,000 ft.

On our return journey a cuckoo was heard calling at 8,000 ft. with a note rather like the Common Hawk-cuckoo, but not so loud or piercing. We were unable to see the bird —Small Hawk-cuckoo? I also heard a call of 5 to 8 notes whistled, but on a level *not* in ascending or descending scale. I have heard this in many parts of the Himalayas, but have never been able to discover the bird. In Nepal it is heard from end of March to May and at no other time. It is very vetriloquistic and sometimes sounds quite close, and a few minutes later very far away. Can any reader enlighten me as to the identity of this bird? I feel it must be a cuckoo of some sort.

Caprimulgus indicus: Indian Jungle Nightjar.

Heard at 8,000-9,000 ft.

Gypaëtus barbatus: Lammergeier.

Seen once only at 9,000 ft.

Glaucidium brodiei: The Collared Pigmy Owlet.

Heard on Sheopuri and on the hills beyond Pati Bhanjyang at 8,000 ft.

A deep hooting 'tu whoo' was heard at 11,000 ft., but we did not get a glimpse of the bird. [*Strix aluco?*—EDS.]

A Buzzard (sp?) was seen at 9,000 ft.

Falco tinnunculus: Kestrel.

A very pale kestrel was seen at 9,000 ft.

Circus macrourus: Pale Harrier.

A male seen quartering the hill-side above Pati Bhanjyang 6,000 ft.

Lophophorus impejanus: Monal Pheasant.

Very common from 11,000 ft. up to 12,000 ft. Little parties of a cock and 2 or 3 hens seen everywhere in the rhododendron scrub in the snow. Less common below the snow line. They were very tame and would allow a very close approach before flying away with wild ringing cries. They were fond of perching on rocks on the edge of the precipices, calling and then planing down the cliff face to a perch far below.

NOTES ON FISHES OF THE GENUS *GLYPTOTHORAX* BLYTH FROM PENINSULAR INDIA, WITH DESCRIPTION OF A NEW SPECIES

BY

E. G. SILAS, M.A.

(*From the Laboratories of the Zoological Survey of India*)

(Communicated by Dr. S. L. HORA)

In determining the systematic position of *Bagrus lonah* Sykes and other glyptosternoid fishes from Deccan, Hora (1938) recognised five species of *Glyptothorax* as occurring in Peninsular India. In addition to the three previously known species, viz., *G. madraspatanus* (Day), *G. lonah* (Sykes) and *G. annandalei* Hora, he figured and described a new species, *G. trawavasae* from the Kistna watershed and a subspecies, *G. conirostre* var. *poonaensis* from the waterways near Poona. After studying the type of Günther's *G. dekkanensis* in comparison with *G. lonah* (Sykes), he found that both were conspecific and stated :

> 'The differences in proportions of the various parts noted by Günther, seem to fall within the range of individual variation, especially as the two types are of very different sizes and are also in different states of preservation.'

Hence *G. dekkanensis* Günther was treated as a synonym of *G. lonah* (Sykes). Speaking of *G. annandalei*, Hora observed:

> 'I am of the opinion that *G. annandalei* Hora, with a much longer and narrower caudal peduncle, probably represents a torrential race of *G. lonah* (Sykes), but in the present state of our knowledge it may be retained for the time being at least as a separate species.'

After examining a number of specimens of *G. lonah* and *G. annandalei*, in the collection of the Zoological Survey of India, Indian Museum, I think, that it is best to consider these two forms as two distinct species. Moreover, *G. annandalei* can be easily distinguished from *G. lonah* by its more slender caudal peduncle and its colouration.

Herre in 1941 described a new species of *Glyptothorax*, viz. *G. housei*, from the Anamalai Hills in South India, and distinguished his species from *G. conirostre* var. *poonaensis* Hora (which form it resembles in its smooth skin) by the following remarks :

> '*Glyptothorax housei* is separated from the above species (meaning *G. conirostre poonaensis* Hora), by the longer barbels, especially the maxillary and nasal ones; the size and lesser height of the dorsal and its greater distance from the adipose fin; the size and position of the anal; the shorter head; and the greater development of adhesive organs.'

In a recent contribution (Silas, 1951), remarks were made on two specimens of *Glyptothorax* from the Anamalai Hills in South India. The specimens were provisionally assigned to *G. madraspatanus* (Day), but it was also noted that, 'They differ considerably from *G. madraspatanus* found in Travancore Hills. . . . It is possible that they indicate an incipient stage in the formation of a new species.' Recently, however, after examining the South Indian representatives of the genus, I am of the opinion, that the specimens described as G. prox. *madraspatanus* and which differ considerably from *G. madraspatanus* (Day), warrant a distinct specific status and as such are christened here as *G. anamalaiensis*, sp. nov.

Thus at present seven species of *Glyptothorax* can be recognised from Peninsular India, viz. *G. lonah* (Sykes), *G. annandalei* Hora, *G. conirostre* var. *poonaensis* Hora, *G. trawavasae* Hora, *G. madraspatanus* (Day), *G. housei* Herre, and *G. anamalaiensis*, sp. nov. Synoptic key for the identification of the above species is give below. To facilitate reference in future, the diagnostic characters of *G. housei* Herre and *G. anamalaiensis*, sp. nov., are given in detail.

KEY TO THE SPECIES OF THE GENUS *GLYPTOTHORAX* BLYTH FROM PENINSULAR INDIA

I. Skin on head and body smooth.

- **A.** Nasal barbel extends beyond eye; maxillary barbels extend for some distance beyond upper angle of gill opening; dorsal origin much closer to tip of snout than to commencement of adipose fin; least depth of caudal peduncle contained $2\frac{1}{2}$ times in its length. ... *G. housei* Herre
- **B.** Nasal barbel falls much short of anterior margin of eyes; maxillary barbels barely reach upper angle of gill opening; dorsal origin almost midway between tip of snout and origin of adipose fin; least depth of caudal peduncle contained 2 times in its length. ... *G. conirostre* var. *poonaensis* Hora[1]

II. Skin on head and body minutely or coarsely tuberculated.

- **A.** Pectoral spine almost as long as head, or somewhat longer; dorsal spine strong and serrated near apex on both edges. ... *G. madraspatanus* (Day)[2]
- **B.** Pectoral spine not as long as head, generally much shorter; dorsal spine moderately developed and smooth throughout. ...

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[1] For a complete diagnosis of this species reference may be made to: Hora, S. L., *Rec. Ind. Mus.*, XL, p. 368 (1938).

[2] Day, F., *Fishes of India*. p. 498 (1877).

1. Maxillary barbels extending beyond commencement of pectorals.
    - (*a*) Skin minutely tuberculated; colour pattern arranged longitudinally.
        - i. Caudal peduncle about $1\frac{1}{2}$ times as long as deep. A light streak along lateral line. Fins with darker bases and lighter margins. *G. lonah* (Sykes)[1].
        - ii. Caudal peducle $2\frac{1}{4}$ to $2\frac{1}{2}$ times as long as deep. Three light streaks along body, one dorsally and two laterally. Fins with lighter margins. ... *G. annandalei* Hora[2].
    - (*b*) Skin coarsely granulated; colour pattern arranged transversely. (Body greyish with two broad white transverse bands; one below dorsal, a second beneath adipose and a third narrow white band at base of caudal fin. A broad transverse white band present at bifurcation of caudal. All fins tipped with white). ... *G. anamalaiensis*, sp. nov.
2. Maxillary barbels barely reach base of pectoral fin. ... *G. trawavasae* Hora[3].

Glyptothorax housei Herre.

1941, *Glyptothorax housei* Herre, *Stanford Ichth. Bull.*, II, (4), pp. 177-178, fig. 1.

To facilitate reference in future, a synopsis of the species based on Herre's description is given below.

D. 1/5; A. 2/10; P. 1/9.

Head 3.9 to 4.1 and depth of body 6.2 to 6.4 in standard length. Skin on head and body smooth. Head longer than broad; eyes situated in middle of head. Maxillary barbels reach beyond commencement of pectorals. Nasal barbels extend to middle or beyond eye. Labial groove widely interrupted. Thoracic adhesive apparatus well developed and longer than head. Pectoral spine strongly serrated internally, and possessing a few serrations on the outer side. Pelvics extend beyond anus, but are separated from anal fin by a considerable distance. Least depth of the caudal peduncle is about $1\frac{1}{2}$ times in its length. Caudal fin deeply forked; its lower lobe the larger. In life the colour is reddish, pinkish or flesh colour with yellow or dusky mottling above, and flesh colour below. In spirit the general colour is blackish, with darker fin bases and lighter margins. Under surface of body paler.

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[1] Hora, S. L., *Rec. Ind. Mus.*, XL, p. 371 (1938).

[2] Hora, S. L., *Rec. Ind. Mus.*, XXV, p. 14 (1923).

[3] Hora, S. L., *Rec. Ind. Mus.*, XL, p. 373 (1938).

Habitat.—Puthutotam Estate, Anamalai Hills, South India.

Glyptothorax anamalaiensis, sp. nov.

1951, *Glyptothorax* prox. *madraspatanus*, Silas, *Journ. Bombay Nat. Hist. Soc., XLIX*, (4) pp. 676-677, Pl. I. figs. 1-3.

D. 1/6; A.3/6/1; P. 1/8; V. 6; C. 17.

Head contained 4 times and depth of body 6½ times in standard length. Skin on head and body coarsely tuberculated. Nasal barbels do not extend as far as eye. Maxillary barbels extend beyond commencement of pectorals. Thoracic adhesive apparatus is feebly developed and is about as long as broad. Least height of caudal peduncle is contained about 2½ to 3 times in its length. Origin of rayed dorsal closer to commencement of adipose fin, than to tip of snout. Pectorals shorter than head and separated from pelvics by a considerable distance. Pelvics overlap anus, but fall much short of anal fin. Pectoral spine pectinated internally. Caudal fin deeply forked. The characteristic colouration of the species has been given in the key on page 369.

Holotype.—No. F. 629/2 and Co-type No. F. 630/2, Preserved in the collection of the Zoological Survey of India.

Habitat.—Streams at the base of the Anamalai Hills, South India.

Remarks.—In its coarsely tuberculated skin *G. anamalaiensis* differs from *G. housei* and *G. conirostre* var. *poonaensis*. The smooth dorsal spine, the less extensive paired fins and the general colour pattern easily distinguishes the new specie from *G. madraspatanus*. From *G. lonah* and *G. annandalei* it can be easily separated by the general form of the body, the coarsely tuberculated skin and the colour pattern. The length of the maxillary barbels which is a diagnostic character, differentiates *G. trawavasae* and *G. anamalaiensis*.

ACKNOWLEDGEMENT

I am deeply indebted to Dr. S. L. Hora, Director, Zoological Survey of India, for his helpful suggestions and guidance in the preparation of this note.

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THE PROTECTION OF WORLD RESOURCES: WILD LIFE AND THE SOIL

BY

LT.-COL. R. W. BURTON, I.A. (Retd.)

'Many are the paths along which man proceeds to destruction, though his main object is his own survival.' (1).

In the article on the formation and purposes of the International Union for the Protection of Nature (2) there is given this definition:—

'The "Protection of Nature" may be defined as the preservation of the entire world's biotic community, or man's natural environment, which includes the earth's renewable natural resources of which it is composed, and on which rests the foundation of human civilization.'

Members who have studied the definition and the article will have realized that the Protection of World Resources is of vital moment to all nations and should have the active interest of all mankind; for it has to be increasingly realized that unless there is universal vision in regard to this subject, the people will surely perish through gradual impoverishment of the world's resources, a process which is much aided in India and other eastern countries by the uncontrolled increase of human populations.

THE LAKE SUCCESS CONFERENCE

Three of the meetings of the International Technical Conference held at Lake Success 22-29 August 1949 under the auspices of UNESCO were devoted to problems of educating children and adults. In the volume of Proceedings and Papers (583 pages bound in grey—the 'Grey Book') is published a number of valuable contributions on the educational aspect of the question. Also on soil protection—ecological research—use and abuse of insecticides—exotic species (both fauna and flora)—vanishing game herds—vanishing wild life—and other matters.

In his introduction to the 'Grey Book' the Secretary-General makes this basic observation:—

'Unless a population is aware of its moral obligation and the material advantages that are to be had by respecting the living communities which form its environment and from which all sustenance is derived, no laws, however severe, can save these natural communities from disintegration and even destruction when some kind of economic profit is at stake.'

That, for instance, is the reason why some of the States governments have had to take over the management of private forests; and why it has to be recognized that the holding of lands is, in a sense, a trust for posterity. No individual or corporation, no matter what the title may be, can be permitted either through ignorance or wilfully to use the land in such a way as to render it liable to erosion.

THE PEOPLE MUST BE INSTRUCTED

It is obvious that in a country educationally backward, as is India, the responsibility for instructing the people in all that affects the protection of world resources—the soil and minerals, the forests, waters and wild life—and the 'family planning'—lies with the government. It can be also correctly asserted that the leaders of the people, the educated classes, editors of newspapers and journalists, priests and clergymen of all denominations, missionaries and teachers in Sunday schools, teachers in universities, colleges and schools have all of them a responsibility and a part to play in this essential matter.

A necessary arrangement towards this end is that there should be created a university degree for the 'Protection of Nature' in all its aspects. Through that method alone can the essential professors and teachers be found, not only in India but in other countries also.

UNCHECKED EROSION SPELLS ULTIMATE EXTINCTION

All the people who have to do with land and things that grow have to be aroused to the necessity of becoming erosion-minded and wild-life minded. It should not be difficult to induce them to think for themselves and realise through the simple use of their own intellect, their own powers of reasoning and observation, how they can best use for the sake of their very existence and well-being all that has been created for them and for posterity.

All this is obvious to those who will trouble to give it a moment's thought, for there is the spectacle before their eyes, wherever they may be, of the wastage of the earth, of the very soil which has been slowly and laboriously formed through the many forces of Nature and upon which the existence of all living things depends. A very little reflection will convince the simplest intelligence that it is because of plant life every living thing exists. Without the soil there could be no plant life; without plant life there could be neither soil nor wild life of any kind, nor any human beings.

These are the foundations upon which educated persons can guide the people to the betterment of their lives; to an attitude of mind and a sympathetic outlook towards the world of nature from which follows a humane and abiding interest in the processes of Nature, the habits of animals, birds, plants, and all living things.

MAN IS THE GREAT DESTROYER

Mankind is the enemy of Man. Man is the great destroyer. In forest areas the systematic annual firing of wooded slopes and hills has resulted in much loss of soil and harm to wild life, as also has the age-long destructive method of 'shifting' hillside cultivation in many forest tracts. By reason of the consequent destruction of undergrowth and soil-binding grasses, erosion proceeds to such lamentable extent that year by year agriculture becomes more and more heart-breaking, wild life more and more scarce.

Rainfall which should soak into the soil rushes down hillslopes, and in many places only the bare rock remains for the struggling vegetation; springs dry up and streams become a mere trickle; birds and animals disappear. Man removes the trees, the shrubs, the grass cover from hilltops, ridges, and their steeper slopes; he sees that through these processes of firing and deforestation—than which there is no surer and quicker way of turning a country into a desert—through these foolish and unthinking processes, the very soil upon which life depends is rushed in muddy torrents to the sea. Yet does he persist in such positively insane doings merely for the purpose of some present and transitory profit!

Here is a living instance. In the Madras District of Chittur is excellent scenery, though in recent years it has been a victim of large-scale vandalism, its forests having been ruthlessly exploited by individuals eager to make money quickly by the sale of timber and firewood. (*Madras Mail* sub-leader, 12th September 1951.) 'Vandalism' it is styled. National suicide it is.

DESICCATION AND DISAFFORESTATION

From early days disafforestation and desiccation of the land proceeds apace. We know from the interesting and informative article by M. S. Randhawa (3) how the face of what is known as the 'Brij' country—the Bharatpur-Agra-Mathura area—covered 2,000 years ago with luxuriant evergreen tropical forests of *Saraca indica* and other trees—has completely changed now. 'The jungles which were the abode of the elephant and rhinoceros have disappeared and in their place we find sandy wastes. . . . The ponds and lakes which were filled with pink and white lotuses and visited by ducks and wild geese, providing inspiration to the Hushana sculpture, have completely disappeared, and in their place we see ravines, sand-dunes, and parched plains. . . .' Blackbuck and chinkara (these in their turn fast dwindling) have succeeded the former pachyderms.

It is probable, though there may have been some shifting of climatic zones, that thoughtless destruction of trees and shrubs, overgrazing, neglect to provide wind-breaks against the high hot-season winds which remove the topsoil in dense black clouds, have been the main causes of the change which has taken place. The desert's 'fifth column' of camels and goats of the wandering tribes will have aided the devastation.

WHAT NOW TO DO?

What could have been done in the past? What now to do? What dyke-building is to the salt-sea, dune-fixing is to the sand-sea. As a defence against encroachment tough, wiry grass is planted in five-yard squares as a net-work to anchor the dunes. Trees such as acacia and tamarisk are planted within the squares and tree-roots and grass knit together as a lasting cover. Through such a method, which has been introduced with success into Tripolitania, there is yet time, not only to restore areas already desert but to halt further extension and make the desert useful to man.

It is refreshing to learn from a recent press report (*Daily Post* of 26 September 1951) that the Government of India have under consideration a 20-year scheme of defence against further encroachment by the Rajputana desert on the fertile Indo-Gangetic plain. This scheme, estimated to cost 5½ crores of rupees, envisages (1) fixation of the sand at different places, e.g. the mouth of the Luni river which empties into the Rann of Kutch, as well as on the seaboard of Kathiawar and Kutch, and (2) afforestation of the region between the river Luni and the Aravalis, the north-west slopes of these hills, and also along the banks of the river Banas.

A Warning from Nepal

It is remarked by Dr. Dillon Ripley (4) that, apart from natural climatic conditions, it will be interesting to observe in future what effect the tremendous deforestation will have on the avifauna and mammalian fauna of Nepal. The lowland forest in the Terai, he says (1947-49) is now reduced to a continuous belt ranging from six to ten miles wide along the northern limit of the Terai, and remarks that, 'This area will probably be somewhat preserved in future, although much of the primary tree growth has already been lumbered, as it is the main hunting ground of the ruling family.' Since that was observed there have been marked political changes in Nepal; so it is possible the area will become curtailed, and with it the estimated fifty rhinoceros which are supposed to be in it.

Further north, he says, lumbering is proceeding in the interior valleys at a rapid rate:—

'. . . and only along the Karnali did we find any virgin timber left. From 1,000 ft. up to over 7,000 ft. throughout the country, intensive agriculture of a shifting nature is practised. The slopes are normally so steep that in many places only one or two crops of potato and cereals can be secured from the newly cleared land before the monsoon run-off has carried away the top-soil. Thus vast areas become mere barren slopes of rock, shale and gravel, and avalanches are common. We found as a result that in many places mid-montane zone birds either did not exist, or could occasionally be glimpsed scurrying from bush to bush as if their lives depended on it, which possibly they did. It seems inevitable that jungle-haunting birds at this elevation will eventually become extinct over large areas.'

In about 1864 the Imperial Forest Department assumed guarding and maintenance of the mountain and sub-montane forests from the Indus to the Sarda River. The question may well be asked: Had that wise provision not been made by the Government, what would be the state of the rivers, canals and plains of the Punjab and Uttar Pradesh at the present day? !

And the Nilgiris

Devastated and eroded areas in the Nilgiris are easier to observe. The traveller by train or bus between Coonoor and Ootacamund cannot fail to see the steep slopes bare of any kind of vegetation, where all the land-cover which supported a varied avian population has been cleared away to make room for crops of potato and cereals. It is obvious to the eye that monsoon rains—which are very heavy at times—will speedily carry away all the soil and leave the bare rock, as has occurred in other parts of these formerly beautiful hills.

WASTE AND ARID TRACTS

All over this sub-continent there are, in most of the Provinces and States thousands of square miles of mostly unremunerative tracts where only a few stunted trees and thorny shrubs sprout amidst stony landscapes; bunch or scrub grasses drain moisture from greater areas than are covered by visible tufts of grass; only cactus thrives and poorly protects the soil, while wind and water erosion is rampant.

Mostly, this has come about through the centuries owing to indiscriminate grazing of too many cattle, depredations of goats and the destroying hand of man. Such desolate areas can be seen from railway or motor through the length and breadth of the land.

HOW TO RESTORE FORMER CONDITIONS?

It cannot be claimed that these tracts would ever yield large size timber on a commercial scale; but were they, or large selected parts of them, set aside for nature to have its unhindered way, within not so many years a coarse and thorny scrub cover would protect the soil. Suitable grasses could be sown, and eventually these extensive areas could provide all the useful products of the many species of acacia and other hardy trees which would assert themselves.

Research scientists and the Forest Department could advise as to selected grasses, trees and shrubs. Cutting of thatching and fodder grasses would be allowed. The recently discovered method of manufacture of straw-boards to save timber utilization could flourish. Wild life would greatly benefit and become a tangible asset; there would be much fodder for improved breeds of cattle, and the climate would improve.

VILLAGE AREAS

Probably it is hopeless to expect the village communities by themselves to re-establish the village fuel woodlands of former days. The shortage of fuel for the rapidly increasing population is such that apart from everything that will burn being stripped from the face of the land, even the roadside avenue trees are being despoiled, and some of them cut down. It is imperative that something effective should be done to satisfy the need for fuel.

Only through the necessary plots being taken over by a government department and organized through inter-village co-operation could the people be assisted to help themselves by proper planting out and maintenance of their fuel, timber and grazing needs.

Much could be written on many kindred matters which vitally affect the village people, but it must here suffice to invite perusal of the publication 'Better Villages' (5) and in particular pages 86-89 of the same. This is recommended to the attention of all who have at heart the interests of the rural millions of this country.

'THE CART BEFORE THE HORSE'

When a house is designed a first consideration is the question of the foundations. Large-scale multi-purpose projects are in the making, and others are on the planning board. Nature's foundations for such projects are the proper conservation of the cover, or provision of cover, to all portions of the catchment areas. But what is actually happening? Even as the huge masonry dams rise and hold the water the eroded hills of the catchment area continue to send down the muddy silt which will eventually render them futile. The Lower Bhavani Project has been remarked upon in the public press as one of such; and Dr. Dillon Ripley is reported in the *Times of India*, Bombay, 5th April 1949, as remarking that the forest along the Kosi river had been cleared and was still being cleared. The result would be, he said, that the soil would not be held in its natural place, and would step down with the river water, fill up the lake, and make the dam 'quite useless'. And this in respect to one of the biggest hydro-electric and flood-control projects in the world! It is just common sense that prior to construction of such projects, hillsides must be planted up and protected by grass, shrubs and trees.

Conservation of Wild Life

Much has appeared in the public press during the past few years regarding afforestation in general, the planting of trees, use of green and compost manure, and so on. In all these high level talks and utterances, and in letters from individuals, there has been no mention of the great need for establishment of a belt of trees along the many thousands of river and stream banks throughout the length and breadth of this country. In many of the tracts where tree planting is advocated, and along many of the highways and other roads, water supply for the planted saplings is the real practical difficulty. Along the river and stream banks that trouble is much less.

It requires small effort of imagination to visualise the great benefit to the climate, to the riverain villages, to wild life in general which would result from these plantations. Much erosion would be stayed, the increase of birds would greatly benefit the farmer. The tamarind would be given prominence and provide their basic food to the monkeys so lessening depredations among the crops. The valuable *mhowa* (*Bassia latifolia*) not being a gregarious tree, would be planted in the open spaces of the countryside.

The Farmers and the Ryots

A minister has said that the government must come to grips with the farmer and compel him to produce more. But before that can be effected, it is necessary for the cultivators of even the smallest holdings to halt avoidable erosion. Within the village areas throughout the country banks of nullahs could be straightened, the earth and stones banked and grassed to retain the soil; and, above all, those long fingers of erosion which thrust into the fields could be dealt with by such measures as present themselves at the site. Where the damage is extensive, the labour could be provided through inter-village cooperation.

Hope for the Future

When the present intensified tree-planting and soil preservation campaigns reach out to the individual cultivators, and the farmers begin to see their lands so much improved—as they will be through the improved conservation methods and efforts of government—the movement will tend to develop very fast. An interest will arise, a public opinion begin to form, and it will be quickly grasped that these sensible methods mean increased agricultural prosperity to all.

In such directions can the Grow More Food and Afforestation campaigns enormously benefit the land. Wild life will increase, the standard of living will increase, and the country be gradually led to national prosperity and political stability.

The Meaning of Vana Mahotsava

Here are excerpts from a letter written by the Hon'ble Mr. K. M. Munshi, Minister for Agriculture and Forests, to Mr. D. F. Karaka which is pertinent to what has been said above.

It was originally published in *The Current* of 26th September 1951, and is now reproduced by kind permission of its editor.

' . . . Life on the globe depends upon Nature's hydrological cycle. There is a certain quantity of water on earth; part of it rises by action of the sun to the sky and comes down in the form of rain. Rain moistens the soil, floods the rivers, fills tanks and waters. On this supply and on the supply of subsoil water depends all life.

Trees and plants, animals including men, are mostly constituted of water. Life on this globe began on account of this cycle. Vegetation and trees were the first forms of life; they built up and enriched the fertile crust on earth and led to the appearance of plants. They prevent the force of rain and let it be absorbed in the fertile crust.

Forests played and still play a most important part in life. They attract rain. They store water, about eighty per cent of every tree being water. They shade the vegetation and plants and enable them to grow. Their falling leaves form the manure which provides food. Their fruits enrich the food supply; their shade protects animals and men from the withering rays of the sun. Dying, aeons ago, they have left us coal; at the cost of their lives, we secure the timber for our houses, railways, ships, furniture and newsprint. Man is the tenderest parasite—though free-moving—of the tree.

Man and his surroundings form an integrated whole; he exists as part of this soil and water and plants and trees of the country in which he lives. With marching civilization, however, we have destroyed forests and have upset nature's equilibrium. In our blindness we think that earth will continue to give food even if we cut down trees on which life depends. In fact, this imbalance leads to erosion, the removal of the nutrient element in the fertile top-soil, the greatest danger to human existence.

This imbalance is increasing at a terrific pace in India. As against the average minimum requirement of forest of 33-1/3 per cent, we have less than 18 per cent of it. Even this area is being reduced at a reckless pace. The banks of some of our great rivers, deprived of trees, have been cut up into ravines. Our mountain sides, in

Himalayas, Vindhyas and the Ghats, due to sheer neglect, are losing their forests; the pegs having gone, the sides are eroded, and the rivers either dry up or are flooded. The Rajasthan Desert, a major menace of India's life, is marching onward at the rate of 50 (fifty) sq. miles a year and eating up our fertile soil of the Ganga Valley. For want of fuel, larger and larger quantity of cow-dung is being used up for fire, taking away another essential manure for our food crops. Some princes, zamindars and landlords have, during the last three years, cut down countless trees to make easy money, before their lands are taken away. Our officers have lost the regard for trees which they had developed under careful British superiors. As a people, we have forgotten our tradition—call it becoming civilised or barbarous as you like,—and do not see the loss of life in the loss of a tree.

I knew nothing of all this when I took up office. I tried to study our food problem, and to my horror, I discovered that India can't grow food unless we grow trees. As in a flash, the truth came to me:

Trees mean water; water means bread; and bread is life.

We had neglected this truth and we are a dying race—like the empire builders in Babylon and Egypt and Central Asia, who disappeared because their land, deprived of trees, and eroded, became deserts, incapable of sustaining life.

I was convinced that we cannot be saved unless we became tree-minded. I read of the frantic attempts of U.S.A., Canada and U.K. to make people tree-minded; for, they are awakened to the danger. What should I do, I asked myself. 'Vana Mahotsava' is the remedy: the answer came.

During the last two years, tree-mindedness has come to us,—to a vast majority with enthusiasm; to a small section in a critical spirit; to a microscopic minority in sneers; and all these are symptoms of negative enthusiasm.

Vana Premi Sangh, founded last year, has branches in most States. All except one University have taken up the movement with great enthusiasm. States, cities, institutions have found an echo of it in their heart. Last year we planted, as we know, 411 lakhs of trees; this year, perhaps the same number or more. Hyderabad State alone has planned to plant this year about 40 lakhs of trees to reclaim eroded land. A school in the South planted over a lakh of trees last year. The village of Settimadamangala, which got the All India Jawahar Shield, this year planted 60,000 trees. 6,000 ladies, young and old, in Hyderabad celebrated the festival with great enthusiasm. I woud like to know another movement which, in so short a time, brought forth such collective enthusiasm.

The survivals of the last year even on a conservative estimate, are one crore trees, which if planted forest-wise, would occupy 50,000 acres and cost crores. But, why so few survivals, ask the scoffers. Because the tree-mindedness is growing, not yet grown; and it can only grow by Vana Mahotsava becoming a part of our national faith. And may I know how many infants, out of those born, survive?

Vana Mahotsava has another side too. Forestry, the Cinderella of the Ministries of Agriculture, is now a princess in her own right, The Central Forest Service has been vitalised and is being reorganised—now proud of its role in the building of the country. The development of the Andamans forest is accelerated; the Dehra Dun Forest College will soon be an international centre; the plywood industry has received some impetus; we have decided to replenish our semal tree resources without which our match-industry will gradually disappear. The U.P. Government has initiated a scheme of a protective girdle against the sinister march of the Desert; and an elaborate scheme has been prepared by my Ministry for an effective afforestation scheme to arrest this monster.

If India becomes Vana Mahotsava-minded, she will live; not otherwise. . . . '

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REVIEWS

1. CONTRIBUTIONS TO THE BREEDING BIOLOGY OF *LARUS ARGENTATUS* AND *LARUS FUSCUS*. By Knud Paludan. pp. 142; 7 plates; tables. Size $9\frac{3}{4}'' \times 5\frac{3}{4}''$. Copenhagen (Ejnar Munksgaard, 1951. Price 20 Danish Crowns (=Rs. 14/-)

The Herring Gull (*Larus argentatus*) and the Lesser Black-backed Gull (*L. fuscus*) are two very closely related species, their chief difference being that in the former the upper parts are pale blue gray while in the latter they are slaty black. There are some minor differences besides, but were it not that their breeding ranges in north-western Europe largely overlap, and are not geographically distinct, they would very well pass for races of the same species. Indeed, in recent years there is a tendency to consider them both as belonging to the same species, their breeding in the same area being explained by their status as the terminal links of a circumpolar chain of races which can freely interbreed with neighbouring races but the ends having diverged so far that upon coming together again they no longer do so. That they are not incapable of interbreeding, however, is proved by the small number of mixed pairs observed on certain breeding grounds. The chief deterrent to their interbreeding on a large scale is apparently the difference in the respective times of their physiological maturity. The Herring Gull usually starts to breed a fortnight or so earlier than *L. fuscus*, which means that by the time the latter arrives and establishes itself on the common breeding ground, nesting activity in *argentatus* is already well advanced, and the opportunity for the formation of mixed pairs no longer present.

Dr. Knud Paludan is the well-known Danish ornithologist whom some readers may remember meeting in Bombay 3 years ago as a member of the First Danish Central Asian Scientific Expedition, on their way to Afghanistan. From November 1942 to April 1947 Paludan, while posted as surgeon on the Christiansö group of islands—lying in the Baltic Sea about 12 miles from the coast of Denmark—took the opportunity of carrying out these very thorough and painstaking investigations on the two species of gull, both of which nest on the island of Graesholm. The comprehensive character of the field work may be gauged from the list of contents of the eight chapters that form the book: The pre-egg stage; pair formation; calls and types of display; behaviour in the pre-egg stage; egg laying; experiments in removal and addition of eggs at different stages; incubation details; hatching pattern and numerous other particulars of the breeding biology of both species.

'The Fate of Eggs and Young' in the two species is a revealing chapter, and the book ends with a comparison of Population Statistics of the Danish *Larus argentatus argentatus* with similar statistical investigations on the American Herring Gull (*L.a. smithsonianus*) revealing significant differences in the mortality rate among different age groups. This works out at about 15% of the breeding population of sexually mature birds in Denmark, as against 29% in American breeding populations. It is estimated that in order to counterbalance this high mortality rate among the adult birds, three times as many chicks must survive in the American populations as in the Danish.

Paludan has made an outstanding contribution to breeding biology literature, and his investigations and technique suggest numerous channels into which the efforts of field workers may be profitably directed. A refreshing feature (*N.B.* super patriots!) is that despite the fact that this is the work of a Danish ornithologist, on Danish material, and carried out on Danish soil, the book is nevertheless published in the English language. It is thus brought within the orbit of a very much wider international field of scientific workers than it could possibly hope to enter otherwise, and enhances its usefulness many fold. There is a summary in Danish at the end for the benefit of such in the country as may not be conversant with English.

The international character of the English language is more patent to-day than ever before, and more and more scientific workers in every country are resorting to it so that their published work may enjoy the widest possible diffusion. A book review is no place for moralising, but it is difficult to resist a comparison between this practical international outlook, and chauvinism of some of our own highly emotional countrymen whose zeal for a national language runs away with them, even to the point of advocating discard of the well-established international scientific nomenclature now in vogue the world over (not excluding countries like the U.S.S.R.) in favour of often still more abstruse and laboured Sanskritised translations of Latin and Greek names. There is no more effective method of hiding our light under the proverbial bushel than this, and it will indeed be a sad day for science in India if workers can be dragooned into adopting this unwise and short-sighted dogma.

S.A.

2. AUDUBON WATER BIRD GUIDE. By Richard H. Pough. pp. xxviii + 352. Size 7¼″ × 4½″. 48 colour plates by Don Eckleberry; numerous line drawings by Earle L. Poole. New York (Doubleday & Co., Inc.), 1951. Price Dollars 3.5

This is one more in the series of excellent books on American bird recognition that have dominated the field since Roger Tory Peterson's 'Field Guide to the Birds' made its first appearance, rightly claiming to be 'A bird book on a new plan'.

The main title is somewhat misleading since the book is not restricted to water birds only but contains a section each on the Birds of Prey (Falconiformes), Grouse (Tetraonidae), Pheasants, Partridges and Quails (Phasianidae), and Pigeon-like birds (Columbiformes). In all 258 American species are treated in colour, depicting the various plumages of each—sexual, seasonal and by age—while 138 line drawings illustrate many of the birds in flight. It is a fact that in the case of some species, particularly of the birds of prey, good black and white drawings of birds on the wing are far more helpful in identification than even a coloured picture of the bird at rest. Both the coloured and black and white sketches are of a high standard of excellence.

The text is concise and furnishes just the information needed by the average bird watcher. It is arranged under the following heads: Field Characters (of adults of both sexes, in summer as well as winter, and of immature birds); Habits (Haunts, food &c); Voice (Calls, songs &c); Nest (Site, structure, eggs, incubation period, whether young nidicolous or nidifugous); Range (Residential and migratory).

A comprehensive foreword gives a good general survey of the aims and technique of modern field study of birds, and forms a useful introduction for the beginner providing helpful hints and suggestions for obtaining the most in pleasure and profit from his bird watching.

Amateur bird students in India have good reason to envy their American counterparts on the availability of such books as Audubon Water Bird Guide. If the youth of India is to enjoy and utilise in proper measure the wealth of bird life with which nature has endowed this country, it is imperative to provide them with suitable illustrated guide books, for which this one may well serve as a model. Lack of elementary and attractive books is the greatest drawback from which bird study suffers in India. If we aspire to produce ornithologists who will one day be able to take their place alongside those of western nations, this is how a beginning can be made—by the provision of simply written, well illustrated books that will generate and sustain an interest in birds, and in nature out-of-doors generally.

S.A.

3. TAIWANIA. Vol. I, nos. 2-4, March 1950. Published by The Laboratory of Systematic Botany, Department of Botany, College of Science, National Taiwan University, Taipei, Taiwan, China.

This is the second issue of this new journal, a newcomer in the field of systematic botany, but one that will cause every botanist all over the world to rejoice. To judge from the contents of the specimen copy that has just come to our Society, the journal deals exclusively with systematic botany in the wider acceptance of the word, that is to say, it contains papers on ecology and geographical distribution of plants in addition to purely taxonomic studies.

It is plain that the final aim of the editors is to bring out a complete and modern flora of Taiwan. The twelve numbers published in the present issue make very interesting reading for any botanist or student of plant geography. Most of the papers have a key to the genera and species of the families dealt with in the respective papers, and occasionally a map to show the distribution of the more important members of the family. The printing is in general clear and neat.

This reviewer has but two remarks to make on the negative side. The first is that some of the scientific names are somewhat carelessly printed, or alternatively that proof reading requires more attention. The second remark is that the various authors seem, no doubt on purpose, to have omitted all vernacular or local names of the plants described or discussed in the papers.

On the whole, however, and in spite of these remarks, we consider this a very fine journal, and the Bombay Natural History Society extends to it and its editors a hearty welcome and wishes it long life and success for the progress of botany in Taiwan.

H. SANTAPAU, S.J.

4. BEAUTIFYING INDIA. By M. S. Randhawa. Rajkamal Publications Limited, Delhi & Bombay, 1950. 28 x 22 cms., pp. 224, plates 23, mostly coloured, several text diagrams.

This is an interesting book both for the ordinary citizen and for the professional gardener and botanist, that is only marred by the poor standard of printing and of colour reproduction. The book 'sums up a lifetime interest in trees and gardens, art and science, aesthetics and joy of life. . . . Guided by science and inspired by nature, Mr. Randhawa writes as one actually talks to a friend. His appreciation of the colours of nature is inspiring and he maintains a deep understanding of the character and personality of every tree that attracts his eye. His book is a treasure house for lovers of nature and tree lore, for persons interested in town planning and garden aesthetics, for students of visual education and for all enthusiasts who seek information on new plants from old.'

The author's introductory remarks explain the aim of his work. 'While we are making plans for increasing the agricultural and industrial wealth of the country, we should not ignore the problem of making the country beautiful. Whilst we are planning to banish poverty . . . with the aid of science and machine, we should also have plans for banishing ugliness of the landscape by planned planting of beautiful flowering trees. We are on the threshold of the Age of Plenty, and let us enter the Promised Land with a lily in our hands.'

Ch. 2 contains a philosophical discussion into the meaning of the term 'Beauty', and here the author does seem to get quite out of his depth. 'Ultimately it is in sex, the urge to propagate the species, that beauty has its source and from sex it derives its power. All other things are beautiful only in a derivative sense.' It does look as if the author has confused the two concepts 'Sex Appeal' and 'Beauty' rather hopelessly. The sight of a beautiful person may indeed excite the sex instincts in the beholder, but where does sex come in, for instance, in the contemplation of a beautiful sunset, or of a beautiful flower? 'No one has ever embraced the Venus of Milo in spite of its beautiful form', says the author, and in these words he gives the game away; we appreciate the beauty of such a statue, but this appreciation is or may be entirely free from any connection with the sexual urge. And coming down to the concrete subject of the book, surely the author does not imply that 'Beautifying India' means making it more sexually attractive. I for one consider Aristotle's definition of beauty ('Symmetry, proportion, and an organic order of parts in a united whole') a far more satisfactory definition than that of W. Durant, or even that of Mr. Randhawa himself; beauty may need a human soul to appreciate it, but, in the common opinion of mankind, it does not need a human soul to express itself.

The chapter on 'Forgotten Flower' is a sincere lament for the oblivion into which many of our most beautiful trees have been relegated among us. There are indigenous trees in India that are second to none in brightness and colour, but unfortunately in the recent past we have, forgetting the real respect that our ancestors had for such trees, allowed them to disappear from our towns and cities. If the book under review had no other effect than to awaken India to a realization of the many floral treasures of the country, Mr. Randhawa might rest happy and content for the rest of his days.

In recent town or country planning we seem to be aiming at efficiency and commercialism; but efficiency does not imply ugliness; our railway stations, roads and streets can be neat and efficient and at the same time be made more pleasant by the careful and selective planting of brightly coloured trees. In this connection the book provides detailed schemes for the planting of such trees in villages, farms, highways and streets, and these chapters deserve careful reading. If, however, India is not going to spend time and money in planting new trees, we should at least aim at preserving our forests and beauty spots; in the matter of nature preservation and national parks, India lags far behind some of the western countries and offers great scope for planners and legislators.

An interesting section of the book deals with the various types of gardens which have evolved in India or been imported by the successive conquerors that have ruled the country. Every successive conqueror has brought his own typical gardening art, and many such gardens are still extant in a living condition, or records of their glories have been left in the rich artistic treasure of the country. Special mention should be made of the Japanese garden, an essentially Indian type of garden, which in the words of Mrs. V. Stuart quoted by the author, 'forgotten in the land of its origin, still survives further east, although so transformed and tinged by the genius of another climate and another people that the garden history . . . . is often misunderstood and overlooked.'

The remarks on annual flower shows read like a fiery condemnation of the apathy that our city of Bombay has in recent years shown to them. This is not the place to inquire into the cause for this state of things, but it is correct to say that such a neglect may explain why our city, which takes pride in calling itself the Urbs Prima in Indis is also one of the drabbest and most colourless cities in India.

All through the book the author insists on the use of foreign trees for gardens and city roads. In my opinion not enough emphasis has been laid on the utilisation of the many indigenous plants that are already available in the country. Our gardeners seem to be reluctant to employ such plants for their gardens, perhaps on the mistaken impression that a tree or shrub to be beautiful must at the same time be an expensive one, and therefore must be of foreign importation.

The last part of the book deals with lists of plants, indigenous or foreign, that can be cultivated to our advantage. The list of scientific names needs careful revision by a competent botanist, as many of the names are incorrect according to the present International Rules of

Botanical Nomenclature. In the Rules the term 'Natural Order' is not recognized; there are Orders and Families, and the author obviously means the latter when he speaks of Natural Orders. Not to tire the lay reader with too much detail, I wish only to note that *Wrightia tinctoria*, a very common wild tree in Bombay, has pure white flowers with a spot of yellow in the centre, not red as the author states; the name *Gliricidia maculata* is consistently misspelt; under some of the plants the modern correct name is mentioned in brackets, but in most cases such a name is omitted; *Ixora parviflora* is a common shrub found in most of our deciduous forests. It is definitely indigenous to India, not a foreign importation.

In the bibliography the name of the publisher is given in some cases, and omitted in others; this may cause some annoyance to the interested reader. One notable omission called my attention in the list of references: Woodrow's 'Gardening in the Tropics' is not mentioned, although it is a popular book among Bombay gardeners, as witness the many editions through which the book went in the early quarter of this century.

The printing of the book is not what one would call aesthetic; the paper is too thin and the lines on either side of the sheet do not always coincide. The headings of the various paragraphs are a valuable asset for the book, but their being printed along the inner side of the page detracts a little of the beauty of the work. As for the colour plates, I have felt a strong disappointment; the colours are dull in comparison with the actual colours of the plants represented therein, and show a very poor standard of printing in comparison with the books of Blatter and Millard or of Cowen. The plates of Ganga Singh in particular I found disappointing; elsewhere I have seen his work reproduced in lively, bright colours, very different from the dull and pale colours of this book. Plates by other authors included in Beautifying India may be artistically very beautiful, but they scarcely give an idea of the tree represented in them.

The author deserves the thanks of patriotic Indians for a very timely book; gardeners, botanists and legislators will find food for thought in every one of its 224 pages. It is regrettable that the presentation of the book is not of the quality of the text.

H. SANTAPAU, S.J.

The following books have been added to the Society's library since May 1951:—

1. Bees—Their Vision, Chemical Senses, and Language. By Karl von Frisch (Cornell University Press, 1950).

2. Nature Through the Year. By Frances Pitt (Macmillan & Co. Ltd., 1950).

3. A Manual of the Geology of India and Burma, Volume I, Third edition, revised and largely rewritten. By Sir Edwin H. Pascoe (Published by order of the Government of India, 1950). (Presented by Government of India).

4. Life in Pond and Stream. By Richard Morse (Oxford University Press, 1950).

5. WILD FLOWERS OF THE CAPE PENINSULA. By Mary Maythan Kidd (Oxford University Press, 1950).

6. HUNTER AT HEART. By B. N. Gordon Graham (Herbert Jenkins Ltd., 1950) (A Review copy).

7. THE CLIMATES OF THE CONTINENTS, Third edition. By W. G. Kendrew (Oxford University Press, 1937).

8. BEAUTIFYING INDIA. By M. S. Randhawa (Rajkamal Publications, 1950) (A Review copy).

9. THE PLAIN NARRATIVE OF THE DOINGS AND DESTRUCTION OF THE MOST MURDEROUS ROGUE EVER KNOWN. By Col. A. Bloomfield (A manuscript copy, presented by Lt.-Col. R. W. Burton).

10. BIBLIOGRAPHY OF THE PUBLICATIONS OF SUNDER LAL HORA—published in commemoration of the Silver Jubilee of Dr. S. L. Hora's first contribution to science. By Jubilee Committee, 1950.

The following books were presented to the Society's library by Mr. & Mrs. Hamid Ali:—

1. THE DUCKS, GEESE AND SWANS OF NORTH AMERICA. By F. H. Kortright (The American Wildlife Institute, 1943).

2. SNAKES OF MAHARASHTRA (in Marathi). By Lt.-Col. K. G. Gharpurey, I.M.S. (Retd.) (Nuthan Marathi Vidyalaya, 1928).

3. SHIKAR EVENTS AND SOME USEFUL NOTES THEREON. By Sahibzada Abdul Shakur Khan, of Tonk, 1935.

4. THE ZOOLOGICAL SECTION OF THE NUZHATUL-QULUB OF HAMDULLAH AL-MUSTAUFI AL-QAZWINI. Edited, translated and annotated by Lt.-Col. J. Stephenson (The Royal Asiatic Society, 1928).

5. VIVARIUM NATURÆ OR THE NATURALIST'S MISCELLANY OR COLOURED FIGURES OF NATURAL OBJECTS, Vol. I. By G. Shaw Nodder & Co., 1790).

6. SYRE-E-PARIND (in Urdu). By Malik Kutub-ud-din (Punjab Press, Sialkot, 1897).

7. THE NATURAL HISTORY OF QUADRUPEDS AND CETACEOUS ANIMALS, Vol. I & II [from the works of the best authors, ancient and modern, 1811].

8. THE NATURALIST'S LIBRARY. Ornithology—Humming Birds Vol. I. By Sir William Jardine, Bart. (W. H. Lizars, & Stirling & Kenney, 1833).

9. TABAYE KHAIWAN (IN URDU).

10. L'INSECTE. Par J. Michelet (Librairie Machette et Cie, 1876).

11. ILLUSTRATIONS OF NATURAL HISTORY—Exotic Insects. By D. Drury (B. White, 1770).

12. THE BIRDS OF AMERICA. By John James Audubon (The Macmillan Company, 1946).

13. JOURNALS OF THE BOMBAY NATURAL HISTORY SOCIETY:
Volume 47, Index Part II (Nos. 3 & 4)
,, 48, No. 4.
,, 49, No. 4.

The following books were presented to the Society's library by the late Mr. Braz Fernandes, Bombay.

1. SOME SOUTH INDIAN INSECTS. By T. Bainbrigge Fletcher (Government of Madras, 1914).

2. REPORT OF THE PROCEEDINGS OF THE SECOND ENTOMOLOGICAL MEETING AT PUSA, 5th-12th February, 1917. Edited by T. Bainbrigge Fletcher (Government of India, 1917).

3. THE NESTS AND EGGS OF INDIAN BIRDS, Vols. I-III. By Allan O. Hume (Second edition. Edited by E. W. Oates), (R. H. Porter, 1889-1890).

4. THE SNAKES OF SOUTH AFRICA. By Fitzsimons.

5. THE POISONOUS TERRESTRIAL SNAKES OF OUR BRITISH INDIAN DOMINIONS (including Ceylon) AND HOW TO RECOGNIZE THEM—With symptoms of snake poisoning and treatment—Third Edition. By Major F. Wall, I.M.S., C.M.Z.S. (The Bombay Natural History Society, 1917).

6. THE STUDENT'S COMPANION IN THE STUDY OF THE NATURAL ORDERS IN BOTANY. By E. Blatter (1916).

7. ELEMENTS OF ENTOMOLOGY—an outline of the natural history and classification of British Insects. By William S. Dallas (John van Voorst, 1857).

8. THE GAME BIRDS OF INDIA Parts I and II. By E. W. Oates (Messrs. A. J. Combridge & Co. 1898-'99).

9. CAMBRIDGE BIOLOGICAL SERIES—The Natural History of some Common Animals. By O. H. Latter (Cambridge University Press, 1904).

10. FIRST BOOK OF INDIAN BOTANY. By Daniel Oliver, LL.D. (Macmillan & Co. Ltd., 1897).

11. INSECT INTRUDERS IN INDIAN HOMES. By E. P. Stebbing (Thacker, Spink & Co.).

12. OUR COUNTRY'S BUTTERFLIES AND MOTHS AND HOW TO KNOW THEM—A Guide to the Lepidoptera of Great Britain. By W. J. Gordon (Day & Son).

13. OUR COUNTRY'S BIRDS AND HOW TO KNOW THEM—A Guide to all the Birds of Great Britain. By W. J. Gordon (Day & Son).

14. CONCERNING ANIMALS AND OTHER MATTERS. By E. H. Aitken ("EHA") (John Murray, 1914).

15. THE YOUNG COLLECTOR: BRITISH BUTTERFLIES, MOTHS AND BEETLES. By W. F. Kirby (Swan, Sonnenschein & Co., 1890).

16. THE YOUNG COLLECTOR: SEA-WEEDS, SHELLS AND FOSSILS. By Peter Gray and B. B. Woodward (Swan, Sonnenschien & Co. Ltd. and The Macmillan Co., 1910).

17. THE YOUNG COLLECTOR: BRITISH STALK-EYED CRUSTACEA AND SPIDERS. By F. A. A. Skuse (Swan, Sonnenschien & Co. Ltd., 1910).

18. A TEXT-BOOK OF ZOOLOGY. By H. A. Nicholson (William Blackwood & Sons, 1894).

19. HOW TO KNOW THE INDIAN WADERS. By F. Finn (Thacker, Spink & Co. Ltd., 1906).

20. ORNITHOLOGICAL AND OTHER ODDITIES. By F. Finn (John Lane, 1907).

21. THE LIFE OF THE GRASSHOPPER. By J. H. Fabre (Hodder and Stoughton, 1918).

22. INDIAN BIRDS AND KEY TO COMMON BIRDS OF THE PLAINS OF INDIA. By Douglas Dewar (John Lane Company, 1910).

23. NATURE SERIES: on the origin and metamorphoses of Insects. By Sir John Lubbock (Macmillan & Co., 1883).

24. A HISTORY OF CRUSTACEA—Recent Malacostraca. By The Rev. Thomas R. R. Stebbing, M.A. (Kegan Paul, Trench, Trübner & Co. Ltd., 1893).

25. RECORDS OF THE NAGPUR MUSEUM: No. 1 The Snakes of Nagpur. By E. A. D'Arbeau, F.Z.S. (Government of Nagpur, 1916).

26. A CATALOGUE OF BIRDS OF SOUTHERN PORTION OF THE BOMBAY PRESIDENCY. By Captain E. A. Butler, H. M.'s 83rd Regiment (Government of Bombay, 1880).

27. THE COMMON SNAKES OF INDIA AND BURMA AND HOW TO RECOGNIZE THEM. By W. H. Cazaly. (The Pioneer Press, 1914).

28. A HAND-LIST OF GENERA AND SPECIES OF BIRDS OF THE INDIAN EMPIRE. By E. C. Stuart Baker (Reprinted from the *Journal of the Bombay Natural History Society* together with a foreword and addenda and corrigenda prepared by the author. The Bombay Natural History Society, 1923).

29. THE JOURNAL OF THE MUSEUM OF COMPARATIVE ZOOLOGY, Vol. II, Nos. 1-2 (Santa Barbara, California, 1921).

30. OUR INSECT FRIENDS AND FOES. By F. Martin Duncan (Methuen & Co. Ltd., 1911).

31. THE JOURNALS OF THE BOMBAY NATURAL HISTORY SOCIETY: Volumes:—

I, IV, VIII, XI, XIV, XV, XVI, XVII, XVIII, XIX, XX, XXI, XXII, XXIII and XXV.

MISCELLANEOUS NOTES

1. ABNORMAL BEHAVIOUR OF A MALE RHESUS MONKEY (*MACACA MULATTA MULATTA* ZIMMERMANN)

A family of the common Rhesus monkey consisting of an overlord, about a dozen females, young ones, and an adult male attracts the attention of many a passer-by in the Calcutta Maidan. The chief centre of interest is the peculiar behaviour of the adult male who, despite his age, is being tolerated by the overlord. Judging from his size, the animal appears to be fully adult, differing from the overlord only in his slender build; but his habits are entirely different. The overlord, as usual, is much dreaded by the members of the family; and except for the occasional sexual acts and the protection against intruders he takes no interest in the family life, generally confining himself to seclusion. The male under report, on the other hand, shows no sexual tendencies and mixes freely with the family. If a female is found lacking in devotion to her baby, he at once snatches it away from her, puts it under his breast in the usual way, and walks away. Knowing the affection which will be accorded to it, the baby eagerly accepts his embrace. Sometimes he forcibly takes away a baby from its mother; at other times, tired of the naughty habits of her charge, the mother herself hands it over to him. In this way he is frequently found fondly playing with the babies, passionately caressing and kissing them, and even trying to suckle them by putting his teats in their mouths. In short, his habits are more or less like those of a mother monkey.

Such feminine behaviour on the part of a male is evidently due to some unbalance of the sex hormones, the estrogen and the androgen. This is also attested by the fact that the skin of the anal and the urinogenital regions has failed to develop the normal red colour.

ZOOLOGICAL SURVEY OF INDIA,
INDIAN MUSEUM, CALCUTTA, H. KHAJURIA
June 9, 1951.

2. TIGER EATING CARRION

At the end of April 1932, I went one afternoon to fish in the Paba River. When I arrived there I saw the Miri village cattle stampeding and an old Miri came along at the end, and told me that a tiger had caught a bull. I asked him to have a machan built, whilst I returned to fetch my rifle.

On coming back, he informed me that an Abor who had been downstream, on returning saw the tiger on the bull and managed to drive the tiger away. The bull got up and struggled back to the village, but died three days later.

The owner buried the carcass where it died, about thirty yards from an old house, of which only the 'chang' was left.

The next morning the headman of the village came and told me that the tiger had dug up the carcass and eaten a portion. As I had never heard of a tiger doing this before, I went along to have a look; it had rained during the night and I found the pug marks of the tiger quite distinct and part of the body exposed and partly eaten. I had it covered up again.

At 7 p.m. I sat up on the 'chang' referred to. It was dark as a storm was coming up. At 7.10 p.m. I thought I saw something and flashed my torch light and there was the tiger by the spot where the bull was buried. I shot it and found it in good condition of 8 ft. 9 in. between pegs.

The tiger could have quite easily killed any other of the village herd as they were all let loose during the three days, but none was attacked.

MURKONG SELEK P.O.,
ASSAM, F. M. NEEDHAM
July 12, 1951.

[On p. 587 of the *Oriental Sporting Magazine* for 1873 Col. Douglas Hamilton writes—

'The common idea that tigers will only eat animals killed by themselves is a complete fallacy . . . . they always prefer putrid to fresh meat. I have often killed a bison and left him untouched in the forest; as long as he was fresh, the tigers, although they would come and walk around him, would never touch him. The moment the bison became putrid the tigers would gorge themselves and never leave off eating, if undisturbed, until the whole was consumed.'

Since then the propensity of tigers for carrion has been frequently recorded and is now well known. Some instances will be found in editorial comments on a note entitled 'Tiger preferring Carrion to live Bait' on p. 1025 of Vol. 31 of the *Journal*.—EDS.]

3. 'AN EXTRAORDINARY FIND IN A PANTHER'S STOMACH'

I think there *is* only one possible explanation for the pointed wooden stake found in the panther's stomach, as described in Miscellaneous Note No. 2. in your journal Vol 49 (4) p. 775.

Your sketch and description of the stake might well be that of a similar stake I found sticking in the lower part of the chest of a bull bison I shot years ago. My trackers recognized what had happened without any hesitation. The bison, entering cultivation at the foot of the hills, had jumped on to a pointed stake deliberately placed inside an inviting gap in the hedge. Such stakes are, of course, intended for deer and pig, not bison; and the stake must have snapped under the bison's weight.

The panther must have either killed an animal that had similarly impaled itself previously; or had come on the impaled animal *in situ*, and made a meal of it. It must have been, too, a very hungry panther, swallowing chunks of meat without thorough mastication. Had a tiger killed the bull bison I have referred to above, or eaten parts of it during the night after it was shot the same thing might have occurred, the stake finding its way into the tiger's stomach.

HONNAMETTI ESTATE,
ATTIKAN P.O.,
VIA MYSORE (S. INDIA) RANDOLPH C. MORRIS
July 4, 1951.

4. 'RABIES IN TIGER'—A DISCUSSION

[Following on the two cases of rabies in tiger reported in recent issues of the *Journal* [Volume 49 (3), 538-541] Mr. S. R. Daver, retired Deputy Conservator of Forests, submitted to the editors a long article attempting to explain the manner in which those animals may have become infected. Mr. Daver puts forward the novel theory that a diet of carrion as such, not necessarily rabies-infected, must be in some way responsible for the spontaneous origin of rabies. He suggests that village dogs and jackals which are the commonest mess-mates of vultures at wayside animal carcasses, initially become infected by pecks from vultures while jostling with them at the feast and in turn spread rabies among the other animals with which they come in contact later. To labour his point that carrion is the source of the rabies virus, Mr. Daver quotes circumstantial (but not very convincing) evidence of a dog which was rigidly guarded against any contact with other dogs contracting rabies on being *presumably* bitten by a bandicoot from a colony whose members, dying through some mysterious epidemic, were found to be carrying 'negri' bodies in the brain. Bandicoots according to him are chiefly carrion eaters.

Mr. Daver, anchoring his arguments on the vulture theory, does not merely suggest but somewhat dogmatically asserts that the appearance of rabies in tiger is due to the animal being pecked by a vulture in the scuffle and confusion that may ensue upon his sudden and unexpected return to his kill to find a horde of hungry vultures busy on it, and on his active resentment of these proceedings. The article is too long to publish in full but this is the more or less accurate gist of it. Further points from the article will become clear from Col. Burton's quotations and his comments on some of them. It has formed the basis for this general discussion of the whole subject of rabies, which it seems useful to record here.—EDS.]

COL. R. W. BURTON, I.A. (Retd.):

'The note contributed by Mr. S. R. Daver purports to explain why rabies in tiger and panther is so rare, and also to trace out and unearth the real culprit among the animals which spreads rabies by contact. He observes that "one cannot presume that rabies organism originates in dogs or in canine tribe and must look elsewhere for the organism''. He remarks that the contention of the author of the article, ''Rabies in Tiger—two proved instances,'' is that dogs are the originators of rabies.'

The above article did not attempt to discuss the origin of rabies. Such little as was said was in connexion with the common knowledge that in the great majority of cases in India it is by dog-bite that the rabies virus is conveyed to other animals. There is no kind of presumption in the article that dogs are the originators of rabies. That dogs, with the jackal, are the most common conveyors of rabies in this country is well known to all of us—to all people.

'It is impossible' writes Mr. Daver, 'for a rabid tiger to die in peace and unproclaimed to the human world.' In reply to that it can be said that many incidents, of various kinds, take place in both near and remote forests which do not become known to outside communities and the world in general.

As to tigers and panthers being found dead in forests and the cause of death unknown, reference may be had to the article by 'Robin Hood' (a forest officer) in Vol X. of the *Journal*; and there was an instance told to the writer some thirty-three years ago by an experienced sportsman shooting in the North Kanara jungles. It should not be dogmatically asserted that cases cannot occur and be unknown to people in general.

Mr. Daver's Argument

Concisely stated, Mr. Daver's argument purports to show that the rabies organism originates—spontaneously—in the dead bodies of animals; that it is the vulture which is the primary keeper and conveyor of the organism of rabies; and that it is through the vulture pecking animals which contest the carcase with the bird that the rabies virus, which is always present in the bird's saliva, is conveyed to the dog and the jackal.

To explain why rabies in tiger and panther is so rare he suggests that the virus is not directly communicated to the tiger or panther for want of opportunity (meaning that the vulture does not often get a peck at these animals). 'Evidently' he writes, 'the rabid tigress of Mr. T. R. Clark's narrative was a victim of a wounded vulture's pecking.' And the tigress being three years old and inexperienced got the pecking from the angry bird. 'The reasons why the cases of rabies in tiger were never recorded in the past is obvious. The contact between vultures and dogs or jackals occurs almost daily, when animals and birds congregate to feed on carrion.'

Mr. Daver also remarks that the virus of rabies is yet undiscovered, so is evidently without the knowledge that the virus can be seen under the electron microscope though not under the ordinary light microscope.

Rabies conveyed by the Vampire Bat

It is known to Pasteur Institute scientists that rabies in the island of Trinidad is conveyed to animals by the bite of the Vampire

Bat of that place. This might lend support to the vulture theory were it not well known to Pasteur scientists that the body temperature of birds being considerably above that of animals it is very difficult indeed for a bird to contract rabies, and under experiment in this connexion it is necessary to lower the temperature of the bird (a fowl, for instance) by immersion in cold water. Mr. Daver gets round this difficulty by assuming that the rabies virus is always in the vulture's saliva because it is a 'carrier' in the technical sense (as apparently must be the Vampire Bat of Trinidad) and so able to transmit the disease without being itself a sufferer. Citing a particular case of rabies being conveyed to a dog by a bandicoot rat he observes, 'This particular case proves that rabies organism originates in dead bodies of animals.' !

Finally, Mr. Daver suggests that, 'A "Vulture Farm" may be established near a Pasteur Institute, and these birds be fed on dead and putrefying bodies: Live animals like dogs, jackals, bandicoot, etc., can be used as "guinea-pigs"—and the vultures may be induced to peck the animals, after they had eaten putrid organs of the dead bodies.' And he makes other suggestions as to what the Pasteur Institutes might do.

RABIES RECORDS

The records maintained by the Pasteur Institute of Southern India, Coonoor, for the years 1908 to 1948 inclusive, show that animals which bit, scratched or licked the 263,736 patients treated included dog, jackal, wolf, hyaena, fox, wild dog, man, monkey, cat, leopard, wild cat, cow, tiger, buffalo, horse, mule, donkey, camel, sheep, goat, pig, rabbit, guinea-pig, mongoose, rat, bear, deer, elephant, cheetah, lion, bullock, calf, fowl, (12 treatments—no death), laboratory infection unknown.

Deaths from hydrophobia caused by dogs were 1,044; by jackal 86; by fox 10; by wild dog 3; by cat 1; by leopard 3; by sheep 1.

In 1948 deaths were caused only through dogs and jackals.

Deaths from hydrophobia in the Madras Presidency during 1913-1948 were 19,380: but the deaths from hydrophobia after antirabic treatment were only 840. For information of the nervous it is made known here that the percentage death rate after treatment covering all those years was only 0.44.

Animals treated with antirabic vaccine during the period 1923-1948, and some of which died during or after treatment were dog, cow, calf, bullock, milch buffalo, goat, horse, pony, elephant, monkey, cat.

EXPERT INFORMATION

Mr. Daver's ideas having been expressed the following excerpts are given, with permission, from the pamphlet, 'Rabies and its Prevention.' By Major H. W. Mulligan, M.D., D.SC., D.T.M., I.M.S. former Director of the Pasteur Institute of Southern India, Coonoor.

'Rabies is an acute disease of vertebrate animals which may affect all animals from amphibia to man. It is particularly prone to affect mammals while birds and cold-blooded animals are relatively resistant.'

'It is a popular though erroneous belief that if a dog can drink it cannot have rabies.'

'The exact biological position of the causal organism of rabies has not so far been definitely determined . . . . In subjects suffering from rabies there is a special localization of the virus in the nervous system and salivary glands.'

'Rabies is almost invariably transmitted to man and other animals through the saliva of rabid animals.'

'So far as is known rabies virus cannot gain entry to the body through intact skin, but if the saliva of a rabid animal comes into contact with skin the continuity of which is broken, infection is liable to occur.'

'. . . . the virus of rabies when deposited on inanimate objects does not retain its vitality and infectivity for long and it is readily destroyed by light, heat and disinfectants.'

'The saliva *may* be infective for as many as 6 days before symptoms of the disease become apparent.'

'It is well established that an animal infected with rabies will usually succumb within 4 days of the onset of symptoms, and it follows, therefore, that if an animal is alive and in perfect health 10 days after biting (6 days plus 4 days) the saliva cannot have been infective at time of biting.'

'Apart from contact with infective saliva it is conceivable that rabies might be transmitted in other ways as, for example, by the consumption of the milk or the eating of the flesh of rabid animals. The chances of infection occurring in this way are very slight since it is known that the virus is present in only low concentration in milk and flesh.'

'However introduced into the body, it is generally believed that rabies virus travels along the nerve trunks to the brain.'

Having read through this typescript, also Mr. Daver's note and the article in the Society's *Journal* (Vol. 49, No. 3), Dr. S. R. Pandit comments:

'Without accepting Mr. Daver's highly imaginative hypothesis of the vulture as a natural carrier of the rabies virus, rabies in the tiger can be explained by facts already known, viz., by conveyance of infection by the bite of a rabid animal, or by the virus entering the tissues through the intact mucous membrane of the mouth by feeding on its prey—a rabid animal; in its later stages of infection, a rabid animal is an easier prey because of the rapidly developing paralysis.'

Perhaps, in the light of personal experience or knowledge some of our members may be able to add materially to this interesting discussion of a subject which has always attracted the interest of man.

COL. J. R. DOGRA, I.M.S., DIRECTOR, HAFFKINE INSTITUTE, PAREL, BOMBAY :

Rabies is an infection of the central nervous system caused by a virus. The virus is often present in the saliva of rabid animals and is consequently most commonly transmitted by a bite. Under favourable circumstances the virus gets established in nerve tissue and migrates to the brain. This may take days or months, hence the uncertain and prolonged incubation period. The diameter of rabies virus has been estimated to be 100 to 150 millimicrons [Galloway *et al* (1)]. Attempts at its cultivation on artificial media have not been successful.

Two instances of proved rabies in the tiger have been recorded by Pandit (5). Both these cases showed negri bodies in the brain. In the first instance, a Bengal tiger severely mauled 18 people but made no attempt to eat any of the victims. In the second instance, again a Bengal tiger traversed long distances, terrorized the inhabitants, attacked 14 persons, 5 head of cattle and a dog. The author suggests rabies as a cause for man-eating propensities of tiger. He further suggests that the unnatural and destructive behaviour displayed at times by other species such as an elephant may result from rabies infection in such animals.

Man and all warm blooded animals are susceptible to rabies. Epidemiologically there are two types, the natural disease of wild animals living in densely forested regions which maintain the original source of infection, and undoubtedly, were the starting points for infection, and, the urban type which is maintained in domestic dogs. The current world wide distribution of rabies is undoubtedly due to the general popularity of dogs as pets.

Legislation against dogs can completely eradicate the disease as has been found in the British Isles—Galloway (2). There have been no reported cases of rabies in the Netherlands or Switzerland for years. Australia and Hawaii are so far free from rabies due to quarantine regulations which were in force prior to the development of large urban centres having the usual complement of dogs.

The readers of this journal would be interested to know that several wild animal vectors of rabies have been incriminated; the fox in western Europe, the wolf in eastern Europe, the jackal in India, Egypt and Anglo-Egyptian Sudan; small rodents in west Africa and Yellow Mongoose (*Cynictus penicillata*) and wild cat (*Felina cafra*) and pepper-and-salt meercat (*Myonax pulverulentus*) in south Africa. In North America, foxes, skunks, bob-cats, mountain lions, and a wide variety of small wild animals are known vectors. Vampire bats in Mexico, Central and South America are the principal vectors of this disease. They infect cattle and have been known to cause considerable damage. The famous epidemic of 1925-29 in Trinidad was traced to the vampire bat (*Desmodus rotundus murino* Wagner) Pawan (6). These were shown to have migrated from South America.

The discovery of rabies among vampire bats marks a new era as it has been shown that the vampire bat is capable of transmitting rabies for several months as a symptomless carrier, Pawan, (7).

Gravel (3) described positive rabies in mongoose and suggested that sporadic cases of rabies where the dog bite or lick is not traced may result from a mongoose bite, either directly or through the mongoose infecting the domestic carnivora, and that 'rabies smoulders in forests and flares in villages and towns'. Gravel (4) further advances the view that in a state of nature (in the wild carnivora) there must be acute and chronic infections. 'Biologically it is not in the best interest of a parasite to be lethal without exception. By being so it would exhaust its nidus and become extinct.'

Mr. Daver in his article suggests tha the vulture may play such a part in nature. It is theoretically possible that a vulture may carry rabies virus from dead or moribund rabid animals and then on pecking a healthy one may transmit the virus and thus spread rabies; but this would appear to be a most uncommon mode of spread. In the case of a tiger the infection may come as a result of combat with a rabid tiger, dog, jackal, mongoose or a rodent.

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5. WILD ELEPHANT SEEKS ASSISTANCE

The following incident experienced by my mahout and myself, will undoubtedly be of interest to your readers.

In April last, coming down the bed of the Bargang river one evening on my male elephant, we crossed a very recent track of a single elephant with her small calf followed by a large tiger. The tracks were so fresh (water was still discoloured in the footprints) that we expected to hear of some domestic trouble very soon. We had not long to wait, for all of a sudden there was tremendous loud trumpeting, with intermittent screams coming from the forest and about 200 yards in. We immediately made for that direction, but as we got nearer to where the sound was coming from, we came into terribly thick cane, with the usual 3 inch thorns, so we had to cut our way through, foot by foot, which delayed us considerably.

All of a sudden a mother elephant appeared holding up her front foot, which was bleeding, and placed her trunk on my elephant's trunk, as much as to say, 'Do come and see what awful trouble I am in!' She turned and led the way; we followed, and approximately 10 yards off, we came on to her calf which was about 3 ft. 6 in. high, standing with its head completely scalped, and holding up its front foot, which was turning round on a piece of skin—its foot, all but severed. With its little trunk about a foot or so long, it kept feeling its terrible head wounds.

We kept moving around slowly, trying to obtain a view of the tiger for fully half an hour, but due to the necessity of continual cutting, we never saw it, although we could see its footprints and smell it.

Whilst we were hunting for the tiger she stood by her calf, never leaving it after having led us to it. We also stayed alongside the calf for full 5 minutes while she herself was holding up her bleeding foot.

It was getting dark, and we had very reluctantly to leave that sad scene and I with a lump in my throat. I have been asked by people why I did not shoot the baby, and put it out of its misery. To me, and to all people who have been associated with elephants, it would have been sheer murder, and mother elephant would never have forgiven me. The baby must have died shortly afterwards.

'Rajbari',
Upper Shillong,
Assam, FRANK NICHOLLS
September 6, 1951.

6. HABITS OF THE MONGOOSE*

As I shall shortly be leaving India after nearly forty-six unbroken years in the country, I bought a copy of your Book of Indian Animals to take to England with me.

One of the first things I turned to was the chapters on mongooses, as these have always been my favourite pets. I have kept more than a dozen at different times.

Regarding family life and care of the young: I wonder if it is known that the young occasionally remain with the mother even after she has had another litter, and actually help her to look after them and teach them to hunt. I can give you one case.

I had a female mongoose named Tilly. When she was full grown, she had a litter of two young ones in her kennel in the store room; but she found me looking at them one day, and straightaway removed them to a burrow in the church garden. She used to come in every evening and beg at the table at dinner time, after eating her meal of raw meat or raw fish. When her youngsters were big enough to eat solid food, she took to bringing them with her. I named them Peter and Bessie. One evening, when Peter and Bessie were about six months old, I was surprised to see six mongooses walk into the house. There were Tilly, Peter and Bessie and three babies about half the size of rats. One of the babies was completely paralysed from the waist down. It dragged itself along the ground by its forelegs with its hind legs trailing behind. When it came to the steps on to the verandah, it could not hop up to them as the other two young ones did, and it started squealing. Either Peter or Bessie, *not the mother,* promptly went to its help and lifted it up the steps! When the adults were busy with their meal of fish, I quickly and quietly picked up the cripple, took it into the bathroom, killed it, and washed it down the flush. After the big ones had finished dinner, they started to collect the youngsters. They searched all over the house for the cripple; then they took the other two babies home to the church garden, and two of them came back to look for the cripple. They were running round the house and calling out all night. My wife and I could get no sleep. They never brought those youngsters to the house again; and soon Peter and Bessie stopped coming and I was left with only Tilly.

According to the *Book* the mongoose is a day hunter; but I have had one who used to go out hunting nearly every night when we retired to bed, and come home in the small hours. Occasionally, when things had gone badly, he would come to my bed, nudge me awake, and want me to get him something to eat, and frequently I would oblige. One night, perhaps having tried to wake me and failed, he went and woke up my wife!! It was a mistake he never repeated. This fellow, as was natural, hunting so much at night, used to sleep three parts of the day.

Both these stories, strange as they may seem, are absolutely true. I think, myself, that the mongoose is perhaps the most intelligent of all mammals, and also an animal in which one finds the greatest diversity of character among individuals.

CATHEDRAL COMPOUND,
MEDAK, DECCAN, W. T. LLOYD-JONES
July 23, 1951.

7. CRAB-EATING CHITAL

In the *Journal* of December 15, 1937 (Vol. XV), I wrote a note on the breeding of various rare birds in the Khulna Sunderbans. The observations were made on a trip in April 1922 which I did with Mr. L. R. Fawcus, C.I.E., I.C.S., who was then Collector of Khulna.

The editors have asked me to put on record one little-known observation which we made at the time. On this area of the coastline in April there was practically no fresh water, and fishermen in the area had to come forty miles to fill their waterskins at some tiny brackish pool where the water welled through the sand. On this foreshore there were considerable herds of chital (*Axis axis*) and numbers of wild pig. Every night at dusk, both chital and pig used to come down and move about over the sands, apparently to drink, where pools of water were left by the receding tide. Very great numbers of crabs haunted the sandy mud, of a species unknown to me. As I recorded later, Mr. Fawcus 'staggered me by insisting that the chital stags we saw trotting about on the sands in the twilight were picking up the little red crabs, which we could watch all day like a dark shimmering line of coral in the distance for ever disappearing down their holes as we approached. Later, one of our policemen (both District Superintendents of Police in Khulna were with us on this trip) showed me the crab remains he had cut from a chital's stomach'.

At the time I was busy with birds and did not realize that this observation would go for years unrecorded. I now do so in the hope that someone, with a greater knowledge of mammals than mine, will be able to confirm it in this area.

CHURCH FARMHOUSE,
GREAT DURNFORD,
SALISBURY,
ENGLAND,
May 16, 1951.

J. K. STANFORD

8. 'THE MOST MURDEROUS ROGUE'

Members who know the Central Provinces may be curious as to item no. 36 *a*. included in the addenda to the Bibliography of Books on Big Game Hunting and Shooting in India and the East published in the August 1951 issue of the Society's *Journal*.

A copy of the illustrated pamphlet, 'The Doings and Destruction of the Most Murderous Rogue' by Colonel Arthur Bloomfield of the Indian Army is in the Library of the Nagpur University and listed, Class B 63 No. 748. The pamphlet was printed by H. B. Crisp, High Street, Sarmundham (Norfolk?). The date is not given in the transcribed copy of it—about 13,000 words—made by Mr. Joseph Fernandez, botanist, of Nagpur and given to the writer of this note. Its hand-written copy is now bound and added to the Society's Library.

WILD ELEPHANTS IN THE CENTRAL PROVINCES

'Historical records and names of places such as "Hathi-Doh" or Elephant Pool indicate that in times past elephants were found in many parts of the Central Provinces, but that is no longer so'. (Dunbar Brander). So also remarks Bloomfield in his pamphlet dealing with the period 1868 onwards: 'There are in the Central Provinces no wild elephants anywhere except the Matin and Uprora Zemindaries of the Bilaspur District some 250 miles from these (Balaghat) jungles. This elephant therefore, hard pressed for companions, was said to pass most of his time with two wild buffaloes, which sometimes, so the rumours were, he used to chastise in his displeasure.'

It was in 1868 that Captain Bloomfield, when Deputy Commissioner of the Balaghat District, first came in contact with this animal which up to that time had not been destructive. He relates that the animal escaped between the years 1830-1840 from its master at Ellichpur in western Berar and eventually found its way some hundreds of miles to the east to the wild and hilly forests of the Balaghat.

It was not until three years later that the elephant began to pull down huts and kill the people. Between January 27 and February 17, 1871, he was in the Mandla District and officially reported to have killed 21 persons (6 men, 8 women and 7 children). The pamphlet gives the official reports which relate that not only did the brute tear the victims into pieces but devoured parts of the scattered corpses. He no doubt commenced this series of attacks in a state of *must*, for during the seven months of the hot weather and rainy season following, nothing was either heard or seen of the animal. With the approach of the cold weather, however, he again became *must* and destructive to the houses, stores of grain, fields and persons of the jungle people. That the reported devouring of portions of his victims was widely credited is gathered from Bloomfield's narrative. 'On the afternoon of the 2nd November (in camp) in walked F. A. Naylor, the District Superintendent of Police, and said, "That man-eating elephant that killed so many people in the Mandla District in the beginning of the year, has appeared in this District and killed and partly devoured a man near Behir". "All right" I said "We must stop his fun, and start as soon as possible." Then began the exciting and dangerous hunt through dense and hilly forests which ended on the afternoon of the 7th November beyond the village of Kaswara when the brute fell to the rifles of Bloomfield and Naylor. The hunt and the final scene, are graphically related. The weapons used were 12. bore breech-loading rifles taking 5 to 6 drams of powder and spherical-faced solid lead conical bullets weighing 6½ to the lb. or 1077 grs.

The animal was in perfect condition, his skin glossy black and under it a thick coating of fat. The tusks were 41 inches long.

The pamphlet is not just a dull narrative, but contains much interest concerning the country, the hills and forests, the jungle tribes, their dwellings and way of life. *Baigas* they were, and it is clear that without the brave and willing aid of these simple people the two Europeans would not have been able to penetrate those difficult forests and come up with the elephant. The Government reward of Rs. 200 seems somewhat niggardly for the destruction of such a beast as this. The money was distributed among the *Baigas*.

During the days of the hunt the monster killed a number of people and pulled down houses. The villages and hamlets of Jagla, Limoti, Godari provided victims; and during the night of November 3/4 ten people were killed in the hamlets of Nandar, Markapahar, Mate, Kesa, Dhatta and Daidi.

'Thus ended the career of what Sir Samuel Baker of African fame told me was the worst rogue elephant he had ever heard of. I certainly think I can claim for him the proud position of being "The Record Monster" whose atrocities have been, or will be seldom or never equalled.'

BANGALORE,
September 1, 1951.

R. W. BURTON,
Lieut.-Col., I.A. (Retd.).

9. WHAT IS THE BEST MEANS OF CONTROL AND DESTRUCTION OF FLYING FOXES [*PTEROPUS GIGANTEUS* (Brünn.)]

A friend of mine in Upper Assam writes as follows: 'Some friends of mine are greatly plagued by the fact that during the past few years thousands of flying foxes have come into residence in three huge trees alongside their bungalow. The trees are literally black with them and they make a shocking noise night and day besides being too definitely repulsive to have any right on the premises.

'They can't cut the trees down but are very anxious to get rid of the pests. The only thing I can think of is to start several *chulas* (braziers) going under the trees on a dead still day when there is no wind and then keep on sprinkling sulphur on the embers. Can anybody suggest anything else to get rid of them? Apart from any other considerations nobody in the vicinity can grow any fruit!'

I should imagine that the above suggestion of burning sulphur in braziers below the trees in which flying foxes roost would only serve to move the pests away to another roosting place. What is wanted is a method of destroying them, or at least of controlling their numbers rigorously, and the high cost of cartridges these days makes shooting a rather expensive means of controlling such numerous creatures.

I note that the fruit-eating bats (Megachiroptera) are scheduled as 'vermin' in the Bombay Wild Animals and Wild Birds Protection Act, 1951. I think the collection and publication of advice on the control and destruction of all vermin, especially wild dogs, wild pigs, rodents, and flying foxes, would be useful.

DOYANG TEA ESTATE,
OATING P.O., E. P. GEE
ASSAM.

Col. Burton who saw the above letter before publication, writes:

FLYING FOXES. I can think of no ordinary method—shooting or the like—by which the flying fox can be controlled or destroyed.

The question is one affecting the whole of India, and should be dealt with by scientists versed in biological control through use of modern methods of use of insecticides and rodenticides.

It may be that some method can be found by which a captured flying fox can be inoculated with some agent which will cause a fatal disease to be passed on by the animal enlarged to its colony. The method would entail the capture and return of one of the species to each colony.

It has to be borne in mind that the flying fox frequents orchards of various kinds of fruits, and DDT used in lethal quantities *may* affect the pollination of fruit tree blossoms.

The several papers contributed by experts to the International Technical Conference, Lake Success, August 22-29, 1949 and published in the volume of *Proceedings and Papers* (the 'grey book' I have styled it) should be read and studied:

'DDT and other Pest Control Chemicals' by Dr. C. H. Curran, pp. 351-358.

'DDT and the Balance of Nature', by Joseph P. Linduska, pp. 362-371.

'Indiscriminate use of insecticides', by Dr. H. S. Pruthi, Plant Protection Adviser, Department of Scientific Research, New Delhi, pp. 372-73 and several articles in French in the same publication.

WILD DOGS. The only way in which the wild dog can be controlled or destroyed is by one or more of the several following methods:—

(i) Shooting when found at kills, or in the forests.
(ii) Trapping—not easy.
(iii) Destroying by means cyanide gas pumped into earths, and breeding dens.
(iv) Poisoning of their kills with strychnine bihydrochloride in liquid form, strength about 10 or 11 grs. to an ounce of water. Method is to pour the poison into deep stabs and cuts and sprinkle on lumps of semi-detached meat.
(v) A poisoning method said to be very deadly is to inject a goat intravenously in an ear-flap by means of a hypodermic syringe with a fairly large needle-bore, care being taken that the bore of the needle remains in the vein and the point does not pierce to the other side on insertion. A 20 c. c. syringe is used and strength of the strychnine emulsion 40 grs. to the half pint of water.

For this goat method it is necessary to find a pool of water at which the dogs are drinking, and sit over the pool to ensure that no one removes the 'easy meat' for home consumption. The goat will fall *apparently* dead, but there may be only extreme and exceedingly painful rigor of the muscles, so a blow at the back of the head with a suitable instrument after, say, half a minute, is humane.

Due care also necessary in case of the first described poisoning method that the jungle people do not eat any of the meat.

The offering of money rewards for destruction of wild dogs gives results.

WILD PIGS. *Outside the forests.* Effective control is through removal of all unwanted cover such as cactus and thornbrakes, and the organization of inter-village pig hunts on a sound basis.

Within the forests. The tiger and panther should be allowed to do their own natural work of keeping down the pig (and monkey) population. The Bombay Government has encouraged the formation of inter-village pig hunts within the forests; and the Madhya Pradesh Government also gives encouragement by providing arms and ammunition. The Madras Government does not encourage these methods. Through use of large-mesh nets and beating out the jungles pig can be killed. *But*, unless the control of the operations is really effective all the edible creatures of the forests will be killed through such a method. And there are other obvious objections, from the point of view of protection of wild life.

RODENTS. *Porcupines* give trouble to certain crops—vegetables, mealies, etc. They are not easy to destroy. Miscellaneous Note by Pitman at page 831, Vol. xxix may be seen. Use of cyanide gas would be effective in burrows with few exits.

Rats, Bandicoots, etc. Cyanide gas methods in use in municipal areas are suitable. But the contribution, 'The rice rats of Lower Sind and their control,' by P. V. Wagle, M.AG. Vol. 32, pp. 330-338 should be read. In regard to rats damaging crops in South India, the notes on that subject by P. N. Krishna Ayyar, B.A., should be read. Perhaps the Sind method might have useful application to some of the Madras rats. The control of all kinds of harmful rodents is for the scientists to direct.

BANGALORE, R. W. BURTON
October 8, 1951. LT.-COL., I.A. (Retd.).

10. SOME NOTES ON THE MALABAR GREY HORNBILL [*TOCKUS GRISEUS* (Bath.)]

In the *Journal,* Vol. 43, page 102, I recorded a few notes on the nesting habits of the Malabar Grey Hornbill (*Tockus griseus*) and have subsequently had occasion to watch at different times two young birds kept in captivity by my brother Shamoon.

They were obtained by Br. Navarro of St. Xavier's College from nests at Khandala, and I am detailing below notes on the adult females taken from the nests along with the young.

The first female taken on 5th May 1943 had not finished her moult, the primaries being shorter than the secondaries; the second mother taken in 1950 had the first primary only about 2 inches long.

In both cases the innermost rectrices were new quills while the outermost pair were bedraggled and frayed indicating that the mould commenced on the inside, as is usual with most birds. The iris of one bird was noted as reddish-brown.

An attempt was made to tame the second bird but she refused to feed and was released in the garden where she clambered up to the topmost branches of a tree and sat motionless for a long time. A piece of raw cucumber tossed up, failed to arouse interest and one piece fell on to the top of its beak. After 15 minutes the cucumber was in the same position, the bird not having moved at all. After some time she disappeared and was not seen again.

The first bird tamed by Shamoon was the larger of two of different sizes taken from the nest on 5th May when they were a few days old. The smaller bird (a female) died after about a month. The first notes were made on 11th July when the bird was 70-75 days old. The iris was noted as grey as against red brown (presumably for the adult) in the Fauna. The beak was horny, the upper mandible slightly darker, and the lower with a greenish tinge. On 6th August, the upper had two thin black lines running along both sides of the culmen, and the beak had developed a slight gap between the mandibles towards the tip (as in the open-bill stork). Uptil now the bill had straight cutting edges with no serrations.

The second naked squab taken in 1950 had the bill dirty bluish grey with the front half yellowish. The feet were still covered with flaky blue skin, the claws being horny and whitish below.

The young were voracious. They ate sliced cucumber, bananas and bits of raw meat, having a special weakness for the last. The bird was adept at catching small articles thrown at him but had to be 'prepared' otherwise was taken unawares. (Primrose, *J.B.N.H.S.*, xxvii, p. 951 records a large pied hornbill catching a swallow as it flew past.) The food was turned round and round in the beak and swallowed whole by the bird tossing back his bill and head. Food once swallowed was often brought up into the bill and sometimes rejected. Large pieces were often seen and felt in the gullet, and if the piece was too big to swallow the bird would get excited and open its wings in its efforts.

On the ground he squatted flat on his tarsus and did not normally hold his tail folded over his back like the African *Lophoceros* (Moreau, *Ibis*, 1940, p. 644) nor was any attempt made at plastering with his droppings which were indiscriminately voided. A nasal 'tain-tain-tain' was uttered all the time, apparently as a purr of satisfaction.

When sitting on one's shoulder he meddled with the ear and nose and often rapidly moved his beak against the cheek. He learned to respond to the owner's whistle which represented the call of the Indian cuckoo.

In September it was noted that though his wings were fully developed and he could fly well, he was reluctant to do so. His usual method of progress was to flap his wings rapidly a few times and then glide for some distance. When flying from one tree to another he would start from the top, glide down to a height of about 5 feet from the ground on the next and then immediately clamber to the top—prepared to glide again. I am inclined to believe that this is a mode of progression which could be used also by the female in case of necessity even with her primaries in moult. Not being caged, the bird would often stray into neighbouring gardens though returning home in the evenings. He was once found on a roadside tree attempting to catch stones pelted at him by local urchins. It was amusing to hear passers-by guessing his identity. The guesses ranged from woodpecker and koel to penguin ! This bird disappeared one day in September.

The second youngster, when fully gorged would sit on his hocks on the bare ground and throw back his head with the beak pointing skywards. This position is presumably an adaptation for a vertical nest hole.

C/O FAIZ & CO.,
75 ABDUL REHMAN STREET,
BOMBAY, HUMAYUN ABDULALI
August 8, 1951.

11. A NESTING COLONY OF SMALL SWALLOW-PLOVERS IN MYSORE STATE

In the survey of birds of Mysore State conducted from November, 1939, to February, 1940, by Mr. Sálim Ali and reported in this journal (Vol. 43, Nos. 2, 3 and 4; Vol. 44, Nos. 1 and 2), the Small Swallow Plover, *Glareola lactea* Temminck, was not encountered. However, Major E. G. Pythian-Adams contributed the information that the species, is 'Very local . . . .' and that he took eggs (c/2) on an island in the Cauvery river below Talakad (Mysore Dist.) 10-4-1937. The following record of a nesting colony discovered in 1951 should therefore be added to the above scanty report.

On May 24, 1951, my sons, Michael and Douglas, and I were pursuing birds, butterflies and mosquito larvae respectively in the vicinity of Sakleshpur, Hassan District, Mysore State (elevation approximately 3,000 feet). One of our explorations took us to the banks of the Hemavati river about half a mile downstream (south) of the town. At this season of the year there had not yet been much rain and the water level was so low that it was possible to wade across the river at numerous places without encountering channels more than knee-deep. The river took a bend at this point and several gravel bars, built up by previous strong currents, were now left exposed. Some of these had no connection with land on either bank and thus formed small island sanctuaries.

On one such island we discovered a colony of nesting birds, such as we had not seen before. Careful written descriptions of them were later provisionally referred to the small swallow plover by Mr. Humayun Abdulali at the Bombay Natural History Society, while at a still later date when I visited the museum in Bombay I was able at first glance to pick out a skin of this species from a trayful of mixed bird specimens. Except for the fact that none of the Sakleshpur swallow plovers was collected for confirmation, there is apparently no reason to doubt the validity of the identification.

About 25 or 30 birds were present on this first occasion. They flew overhead with the behavioral antics of colonial nesting birds such as terns, doubling back and forth and continually diving at our heads. Being somewhat deaf I shall not attempt to describe their notes other than to say that they were not harsh like terns but of a more mellow plover-like timbre. Frequently one or several birds would alight nearby and squat on the coarse sand as if on a nest, spreading their wings as if sheltering young, or moving their bodies from side to side as if adjusting eggs beneath them. They managed almost invariably to do this in such a position as to face their observers squarely. When these birds were approached they would scuttle away, either dragging a wing or beating it on the sand as if it were broken. If the observer stopped, the birds would again squat as if on a nest. Upon being further pursued, they would again adopt the broke wing tactic until the water's edge was reached. Then they would fly off to join the circling birds overhead.

At the centre of the island we found many depressions resembling nests, some of these not more than two feet apart. These showed no evidence of being more than scooped-out hollows, that is, there did not appear to be any deposition of specially gathered pebbles or other materials in their centers. Only a few of the nests contained eggs, but the structure of empty nests was the same as that of occupied ones. Three nests containing eggs were found. The clutch was two in each case. One egg, inadvertently broken, was within a few days of hatching. No nests with young were seen, but as young pratincoles are precocious this was not remarkable. A search was made for partly-grown fledglings hiding under refuse and debris on the island, but none was found. A few fully fledged birds were seen. These were browner than the adults and their feathers had narrow buffy edgings, giving them a scaled appearance similar to that of some species of young terns.

On June 3, I returned to the island alone. There had been a fairly heavy rain in the interim and the river had risen, causing a decrease in the size of the island. Fewer adult birds were about, but they still behaved like nesting individuals. One nest with two newly-hatched chicks was found. These were fluffy and protectively mottled. Despite its youth, one of them jumped out of my hand and attempted to run away.

By June 12, the monsoon had caused a sharp rise in the river and the island was completely inundated. Although I wandered along the west bank for several furlongs, thinking that the remaining young birds might have managed to find a sheltered stretch of shore, I could not see a single swallow plover of any age. The nesting success of the colony was therefore probably partially reduced by the onset of the monsoon. But I suspect that our discovery of the colony may have been late in its seasonal history, and that many young may have been fledged before that time. Major Phythian-Adams's April egg date would support such a view. An effort will be made to test this impression next year, provided similar islands reappear in the Hemavati and swallow plovers return to Sakleshpur.

3, St. Marks Road,
Bangalore,
September 17, 1951.

C. BROOKE WORTH

12. OCCURRENCE OF THE PHEASANT-TAILED JAÇANA [*HYDROPHASIANUS CHIRURGUS* (SCOPOLI)] IN MADRAS

Mr. J. M. Forrow of Simson & McConechy Ltd., Madras, has sent us a sketch and description of a bird which is undoubtedly the Pheasant-tailed Jaçana in breeding plumage, which he observed on the banks of the Adyar river near Madras on the 25th June 1951.

Whistler in the 'Vernay Scientific Survey of the Eastern Ghats' states that there is no information about the occurrence of this species in the Madras Presidency except for one skin in the Madras Museum and two others obtained by Wardlaw-Ramsay (one undated, and one 1876) in the British Museum.

Mr. Forrow saw this for the first time in 16 years residence in

Mr. Forrow saw this for the first time in 16 years residence in

114, Apollo Street,
Fort,
Bombay,
July 19, 1951.

EDITORS

13. MORNING AND EVENING BIRD CALLS

The following observations on the succession of bird calls at dawn and dusk were taken on May 7, August 2 and 3, 1951. They were recorded in the Forest Office compound at Ranchi. This compound is about 26 years old. Both large and small trees occur, some of them being very old. Hedges, bushes, seasonal flowers, and open spaces with grass are all intermixed. Sometimes rare birds are met as winter visitors which are not found in any other compound in the neighbourhood. My conclusions are not definite, but generally it may be said that at the commencement of the breeding season in May, the Black Drongo starts calling earliest; whereas when young birds are about, the crows and mynas are the earliest risers. The end of calling is even more indefinite in the evening, but it would appear that the drongo, crow, and the mynas are the last to call before retiring. Of course, in moonlight, the Koel keeps up its chatter intermittently throughout the night; whilst the Spotted Owlet is also generally vocal at all hours of the night.

May 7, 1951.

4.05	a.m.	Soft calls of Black Drongo (*Dicrurus macrocercus*).
4.07	,,	Second drongo joined in from the western side.
4.08	,,	The Koel (*Eudynamis scolopaceus*) followed.
4.09	,,	The second Koel joined in.
4.11	,,	Two drongos and Koels.
4.13	,,	Another drongo from a different quarter.
4.15	,,	Koels and drongos at a high pitch, from all directions.
4.16	,,	A lull.
4.40	,,	Drongos and Koels.
4.41	,,	Koel, House Crow (*Corvus splendens*).
4.42	,,	Koel, crow, Dhayal (*Copsychus saularis*) in low pitch.
4.43	,,	Dhayal, Koel, Common Myna, (*Sturnus tristis*).
4.45	,,	Second myna took part; Dhayal in full song; Koel.
4.46	,,	Black-headed Oriole (*Oriolus xanthornus*) joined in.
4.48	,,	Second Black-headed Oriole from a different quarter joined in; Dhayal, 2 Night Herons (*Nycticorax nycticorax*) passing the compound and calling.
4.49	,,	Dhayal, myna, Red-vented Bulbul (*Pycnonotus cafer*).
4.50	,,	Second bulbul joined in; Myna, Crow, Koel.
4.51	,,	Bulbul, myna, Koel, drongo, Dhayal, all at a high pitch.
4.52	,,	Spotted Owlet (*Athene brama*), Pied Myna (*Sturnus contra*), Common Myna, bulbul.

4.53	a.m.	Tonk-tonk of Crimson-breasted Barbet (*Megalaima haemacephala*); Drongo.
4.54	,,	White-eye (*Zosterops palpebrosa*); Pied Mynas, Common Mynas, Koel, barbet, Baya (*Ploceus philippinus*).
4.55	,,	Barbet, Pied Myna, Myna.
4.56	,,	Pied Myna, barbet, Koel, Dhayal.
4.57	,,	Pied Mynas, White-eyes, Dhayal.
4.58	,,	Crows, Yellow-cheeked Tits (*Parus xanthogenys*), Dhayal, Spotted Dove (*Streptopelia chinensis*), Night Heron.
4.59	,,	Another dove from the west.
5.00	,,	Another dove from the east; Yellow-cheeked Tits, barbets.
5.01	,,	All doves together, myna, Koel, barbet.
5.03	,,	Koel, bulbul, myna, tits.
5.04	,,	Crow, drongo, dove.
5.05	,,	House Sparrow (*Passer domesticus*), crow, bulbul.
5.06	,,	Sparrow, dove, and bulbul.
5.07	,,	Grey Shrike (*Lanius excubitor*), occasionally calling.
5.08	,,	Bulbul, dove, Baya, myna.
5.09	,,	Pariah Kite (*Milvus migrans*) gave a few screams.
5.12	,,	Baya, dove, Koel, myna.
5.13	,,	Two owlets chuckling together.
5.14	,,	Bulbul, Pied Myna, Common Myna at high pitch.
5.15	,,	Drongo started calling again.
5.16	,,	Two drongos together, two owlets, Baya.
5.17	,,	Bulbul, Koel, Pied Myna, Common Myna.
5.19	,,	Small Minivets (*Pericrocotus peregrinus*) calling.
5.20	,,	Dhayal.
5.21	,,	Barbet, drongo, dove.
5.22	,,	A lull.
5.23	,,	One Laggar Falcon (*Falco jugger*) taking short flight but not calling.
5.24	,,	Dove, Koel, myna.
5.25	,,	Doves, orioles, Dhayal.
5.27	,,	Bulbul, Pied Myna, sparrow, Baya.
5.28	,,	Koel, dove, Baya.
5.29	,,	Dove tits.
5.31	,,	Owlets, Marhatta Woodpeckers, (*Dendrocopus mahrattensis*),
5.32	,,	Drongo, tits, myna.
5.33	,,	Pied Myna, Common Myna, Koel, bulbul, dove, continuing.

The morning was cloudy, and a light westerly breeze was blowing. The ground was wet due to heavy rain the previous night. Sunrise, about 5.33 a.m.; temperature: maximum, 103°F; minimum, 75°F.

Evening Observations; sunset at 6.23 p.m.

6.24	p.m.	Pied Myna, myna, dove, Koel.
6.25	,,	Pied Mynas, Common Mynas.
6.27	,,	Drongo, tits.

6.28	p.m.	Rose-ringed Parakeet (*Psittacula krameri*), making a lot of noise on a mango tree.
6.30	,,	Drongo, Koel, parakeets.
6.31	,,	Myna; Dhayal singing softly.
6.32	,,	Pied Mynas, several together.
6.33	,,	A lull.
6.35	,,	Bulbul, drongo, myna.
6.36	,,	Owlets, bulbul, drongo.
6.39	,,	Drongo, bulbul, myna.
6.40	,,	Barbet, Pied Myna, Common Myna, Koel.
6.41	,,	Plaintive *swee-swee* of Dhayal; Koel, crow.
6.43	,,	A lull.
6.44	,,	Owlets, House Swift (*Apus affinis*).
6.45	,,	Second owlet joined in; drongo.
6.47	,,	Pied Myna, Koel, drongo, crow.
6.48	,,	Drongo, Koel, crow.
6.49	,,	A lull.
6.51	,,	Drongo, owlet, Koel.
6.52	,,	Koels at high pitch.
6.53	,,	Drongos, Koels.
6.55	,,	Koel, myna.
6.56	,,	*Swee-ee* and *Chr-r* of a Dhayal.
6.57	,,	Drongo, myna.
6.58	,,	Drongo, koel.
6.59	,,	Koel, drongo, continuing.
7.00	,,	Perfect silence prevails after the day's hard struggle for food, nest building, etc. All fast asleep.

August 2, 1951.

5.00	a.m.	House Crow.
5.02	,,	Myna.
5.03	,,	Second crow and myna join in.
5.05	,,	Pied Mynas join the Common Mynas.
5.06	,,	Pied Mynas, Common Mynas, crows.
5.07	,,	A lull.
5.10	,,	Koels from different directions.
5.12	,,	Pied Mynas, Common Mynas, owlet.
5.14	,,	Second owlet joined in, Pied Mynas, Common Mynas, crows.
5.15	,,	Bulbul, mynas.
5.16	,,	Second bulbul came in.
5.17	,,	Bulbul, mynas.
5.18	,,	All silent.
5.26	,,	Crow, Koel.
5.27	,,	Another crow from the west.
5.28	,,	Another crow from the east.
5.29	,,	All crows together, Koels.
5.30	,,	Tits, dove, Pied Myna.
5.31	,,	Second dove, tit, bulbuls.
5.32	,,	Another tit joined; doves, bulbuls
5.33	,,	Four doves in chorus; Koel.

5·34 a.m. A lull.
5·40 ,, Soft call of a Dhayal.
5·42 ,, Doves, tits, bulbuls.
5·43 ,, Doves, tits, and koels at high pitch.
5·44 ,, Crows, Pied Mynas, Common Mynas.
5·46 ,, Koels, crows, mynas.
5·50 ,, Small party of White-eyes hunting amongst the foliage of a Toon (*Cedrela toona*) tree, and uttering jingling notes all the time.
5·51 ,, Pied Mynas, Common Mynas, bulbul, White-eye.
5·53 ,, Two Night Herons were going to their roosting grounds and *kwaak*-ing all the time; Dhayal.
5·54 ,, Koel, Pied Mynas, Common Mynas.
5·56 ,, A drongo whistling from the north; doves.
5·57 ,, Doves, crows, Koels.
5·58 ,, Another drongo from the east, Pied Mynas, doves.
6.00 ,, White-eyes, mynas, doves.
6.03 ,, Small Minivets, doves.
6.04 ,, A lull.
6.08 ,, Doves, crow, Pied Mynas, Common Mynas, bulbul.
6.09 ,, Crows, mynas, doves.
6.10 ,, Doves, mynas, kite, and a Scavenger Vulture (*Neophron percnopterus*) flying about but not calling.
6.11 ,, Two young Koels making a noise while being fed by a crow.
6.12 ,, Young Koels, barbet, bulbul.
6.13 ,, A lull.
6.16 ,, Barbet, crows.
6.18 ,, Tits.
6.19 ,, Mynas, bulbuls, tit.
6.20 ,, Silence.
6.28 ,, Parakeets.
6.29 ,, Shahin Falcon (*Falco peregrinus perigrinator*) flying low but not calling; Pied Mynas give alarm.
6.30 ,, Parakeets, barbet, myna, bulbul, young Koel, Tickell's Flowerpecker (*Dicaeum erythrorhynchum*).
6.33 ,, Small Spotted Eagle (*Aquila pomarina*) sitting on a branch but not calling.
6.34 ,, Mynas, doves, barbet.

Sunrise approximately at 6.35 a.m. The morning was very cloudy, and it was difficult to observe the exact instant at which the sun rose. There was no wind, and the morning was very calm and motionless.

Evening; sunset approximately at 6.25 p.m.

6.26 p.m. Young Koels, Pied Mynas, Common Mynas.
6.27 ,, Cattle Egret (*Bubulcus ibis*), Pied Mynas, young Koels.
6.28 ,, Pied Mynas, doves.
6.29 ,, Koel, Common Myna, young Pied Mynas.
6.30 ,, Mynas, crow.

6.31	p.m.	Young Koel; 4 crows together; Koel.
6.33	,,	Young Koels, Koels, crows.
6.34	,,	Pied Myna, Common Myna, Koel.
6.35	,,	Mynas.
6.37	,,	Pied Mynas, Common Mynas, crow.
6.38	,,	A lull.
6.39	,,	Barbet, Pied Myna.
6.42	,,	Second barbet took part; Pied Mynas.
6.43	,,	Two drongos, crows.
6.44	,,	White-eyes, crows.
6.45	,,	Drongo, barbet, crow, Pied Myna.
6.46	,,	Owlet, drongo; Koel, two from different directions.
6.47	,,	Another owlet, Shahin Falcon, young Koels.
6.48	,,	A lull.
6.50	,,	Young Koels, crows, Night Herons going to feed.
6.51	,,	Complete silence.
7.00	,,	Two Koels from north and south, owlet.

Evening cloudy, still and hot. Sun not visible for the most part. Sunset observed with difficulty.

August 3, 1951.

5.10	a.m.	Myna.
5.12	,,	Several mynas joined in.
5.15	,,	Two Pied Mynas, Common Mynas, crow.
5.21	,,	Several Pied Mynas, Common Mynas in chorus, crow.
5.22	,,	Owlet, Pied Mynas, Common Mynas.
5.23	,,	Second owlet from a different quarter, mynas.
5.25	,,	Pied Mynas.
5.27	,,	Pied Mynas, Common Mynas, Crow.
5.29	,,	Koel, Common Mynas, Pied Mynas.
5.30	,,	Another Koel took part.
5.32	,,	Two Koels together, Pied Mynas.
5.34	,,	Third Koel from the north, crows.
5.36	,,	Koel from the north, mynas.
5.37	,,	Silence.
5.50	,,	Crows, young Koels, Pied Mynas.
5.51	,,	Crows, Pied Mynas, Common Mynas.
5.53	,,	Crows, Koels, Pied Mynas, Common Mynas.
5.54	,,	Two Night Herons called while passing the compound.
5.56	,,	Two crows making noise while feeding young Koels.
5.57	,,	Koels, mynas.
5.58	,,	Parakeet.
6.00	,,	Bulbul.
6.01	,,	Bulbul, Pied Mynas.
6.03	,,	Bulbul, Pied Mynas, Common Mynas.
6.04	,,	Pied Mynas, Common Mynas, Crow, White-eyes.
6.08	,,	Bulbul, crows, mynas.

6.09	a.m.	Dove.
6.10	,,	Dove, mynas.
6.12	,,	Young Koels, dove, mynas.
6.13	,,	Parakeet, dove.
6.15	,,	Second dove joined in; crows.
6.17	,,	Flowerpeckers, dove, young Koels.
6.18	,,	Barbet, doves.
6.20	,,	Bulbuls, barbet.
6.21	,,	White-eyes, dove.
6.23	,,	Mynas, dove, crow.
6.24	,,	Two Koels, crows, mynas.
6.26	,,	Doves, Koels, crows, Pied Mynas, Common Mynas.
6.27	,,	Barbet, bulbul.
6.28	,,	Koels, Pied Mynas, Common Mynas. crows.
6.29	,,	Two Doves, Pied Mynas, Common Mynas.
6.30	,,	Barbet, bulbul, young Koels.
6.31	,,	Young Koels, crows, mynas.

Raining heavily; time of sunrise not observed.

Evening; sunset approximately 6.25 p.m.

6.30	p.m.	Mynas, barbet, young Pied Mynas.
6.32	,,	Pied Mynas, Common Mynas, barbet, young Koel.
6.33	,,	Koel, barbet, Pied Mynas, mynas.
6.34	,,	Mynas, young Pied Mynas.
6.35	,,	Young Pied Mynas, young Koel.
6.36	,,	Pied Mynas, Common Mynas, dove.
6.37	,,	Barbet, Mynas, Dove.
6.38	,,	Pied Mynas, Common Mynas, barbet.
6.39	,,	Mynas, barbet.
6.40	,,	Parakeet, House Swift, barbet, mynas.
6.41	,,	Pied Mynas, Common Mynas, barbet, Koel from the west.
6.42	,,	Koel, young Mynas, Mynas.
6.44	,,	A lull.
6.45	,,	Crow, young Koels, Koels.
6.46	,,	Crows, young Koels, mynas.
6.47	,,	Two drongos, dove, crows, young mynas.
6.48	,,	Crows.
6.49	,,	Drongo from the west; crows.
6.50	,,	Silence.
6.51	,,	Drongo, crow, young myna, owlet.
6.52	,,	Two owlets together, mynas, crows.
6.54	,,	Six Night Herons going to their feeding grounds; crows, drongo.
6.55	,,	Silence.

The evening was clear and hot, but the sun was partly obscured, thus making time of sunset difficult to observe.

Several birds visit this compound for breeding only, e.g. Baya and Sparrow, and are not seen thereafter. Others like the Grey Shrike and the oriole are more common in the cold weather, and the drongo comes only occasionally, mostly in the evening after the breeding season. Night Herons and Cattle Egrets do not live here, but only pass through. The Shahin Falcon and the woodpecker are irregular visitors.

JAMAL ARA

14. STRAY BIRD NOTES FROM TIBET

I have just returned from what is, I fear, my last trip in Tibet. I visited Lhakhang Dzong which you will find on the Tibet-Bhutan border where the Lhobrak river pierces the Himalaya. The existence of an opening in the Himalaya makes it possible for South Himalayan birds to enter Tibet and I am sure that if it ever becomes possible for any observer to stay in that area, the number of Himalayan species recorded with a Tibetan distribution will be increased.

The country for some 30-40 miles up the Lhobrak river in Tibet has a mixed deciduous (mainly birch) and conifer forest and I found the following birds as far up as to within 4 miles of Se (Tse).

Nutcracker. The Himalayan species *hemispila*.
Bullfinch (*Pyrrhula erythrocephala*).
Himalayan Cole Tit (*Lophophanes ater aemodius*).
Green-backed Tit (*Parus monticolus monticolus*).
Himalayan Goldcrest (*Regulus regulus himalayensis*).
Red-flanked Bush Robin (*Ianthia cyanura rufilata*).

These were all numerous.

In the same area there were Snow Pigeons (*Columba leuconota*) Blue-headed Redstarts (*P. frontalis*) and Accentors (*Prunella strophiata*). Also the same laughing thrush which is common on the Tibet side of the Nathu La (which I think is *Trochalopteron affine affine*), a pipit, probably Richard's, (*Anthus richardi*) and the Himalayan Jungle Crow (*Corvus m. intermedius*).

At the Pemaling Ishho (Lake) I saw a flock of over 30 Hodgson's Grandala, Rubythroats, a *Laiscopus* which I took to be *collaris nipalensis, Prunella atrogularis*, Bluethroat, *Chaimarrhornis leucocephala*, also Güldenstadt's Redstart and the Eastern Indian Redstart, a chat like the Indian Bush Chat but without an orange-red breast.

I may add that in the deciduous/conifer forest area I saw twice, but never distinctly, a dark blue bird with whitish sides which I thought might be Hodgson's Shortwing.

I find from my notes of past years that a bird I saw in a valley off the Brahmaputra near Samye and in other places, appears to be the Daurian Redstart, and that there is a martin in many parts of Tibet which is neither the Crag Martin nor the Sand Martin but has a much shinier black on the wings and body and a conspicuously white rump. It looks like a House Martin but I do not think Ludlow mentions this in his Bhutan list.

C/O GRINDLAY'S BANK,
6, CHURCH LANE,
CALCUTTA,
November 7, 1950.

H. E. RICHARDSON

15. BREEDING OF THE GREEN PIT VIPER (*TRIMERESURUS GRAMINEUS*)

As there appears to be very little information regarding the breeding of this Pit Viper it might be of interest to record that a few days back we acquired a live specimen from a snake charmer said to have been obtained at Matheran. This gave birth to 7 live young and also expelled one infertile egg on 9th June, 1951.

The mother takes a mouse 3 or 4 times a week, but there is no evidence to show that the young have eaten anything so far. The mother with all her youngsters remain throughout on the plant that is provided in the cage, and she too does not show any inclination to attack her prey for feeding unless removed by force from the plant.

VICTORIA GARDENS,
BOMBAY,
June 22, 1951.

J. N. BAROOA
Assistant Superintendent (Zoological).

[In the *Journal*, Vol. xxi, p. 1339, Mr. N. B. Kinnear records 15 young born in our Museum on 30th June.—EDS.]

16. SURFACE-LOCOMOTION OF CERTAIN FROGS (*RANA*), AND THE OCCURRENCE OF *R. TAIPEHENSIS* VAN DENBURGH IN INDIA.

This note is an amendment and amplification of my comments on surface-locomotion in certain species of *Rana*, particularly *R. erythraea* Schleg., which appeared in 1947 in this journal, (Vol. 47, pp. 173-174). When publishing the record of this uncommon habit as having been observed in a colony of *R. erythraea* at Mymensingh, Bengal in July, 1944, I had followed Boulenger in using the name *erythraea*. Boulenger (vide his remarks in *Records of the Indian Museum*, Vol. xx 1920,) did not accept *taipehensis* as a species distinct from *erythraea*. However, having subsequently discussed these frogs with Dr. Malcolm Smith (to whom I submitted specimens from Mymensingh for examination), I am convinced that there is ample justification for accepting the smaller *R. taipehensis* as distinct—and to which species, as pointed out by Dr. Malcolm Smith, my specimens from Mymensingh will have to be referred.

During the course of studying the specimens of *R. taipehensis* and *R. erythraea* in the British Museum (Natural History), I happened to notice some remarks by Major S. S. Flower on the label attached to a specimen of *R. erythraea* which he had collected at Singapore in 1896. Consequently, I referred to Major Flower's paper in the *P.Z.S.*, 1896, pp. 856-914, wherein he remarks of the latter species:—'This is a most active, agile frog, both on land and in the water; it can hop over the surface of a pond, much as *Rana cyanophlictis* does in India, and also jump right out of the water.'

Whereas I am undoubtedly at fault for not being aware of Major Flower's record when my note was published in this journal in 1947, it is extremely interesting to know that both *R. erythraea* and *R.*

taipehensis can hop over the surface of the water. The other interesting point is that this appears to be the first published record of *R. taipehensis* in India, and represents the western limit of its known distribution.

I would like to express my thanks to Dr. Malcolm A. Smith and Mr. J. C. Battersby, both of the British Museum (Natural History), for their kindly advice and assistance.

c/o MINISTRY OF SUPPLY,
TROPICAL TESTING ESTABLISHMENT,
PORT HARCOURT, NIGERIA,
WEST AFRICA.
July 10, 1951.

J. D. ROMER,
M.I.Biol., F.Z.S.

17. HILSA CATCHES ON THE KODINAR (KATHIAWAR) COAST

In the last issue of the *Journal* (Vol. 49, pp. 614-623), Dr. C. V. Kulkarni in his paper on the Hilsa Fisheries in the Narbada River, has remarked that 'Chaksi' is the local name of *Hilsa ilisha* and the name of *H. toli* is 'Palwa' on the Kodinar Coast. He also suggested that the export figures of *H. ilisha* given in my paper on the Marine Fisheries of Kodinar (*J. Bombay Nat. Hist. Soc.*, 48, pp. 47-61) relate to *H. toli* and those of *H. toli* to *H. ilisha*.

I had the opportunity of corresponding with Dr. Kulkarni on this matter and he very kindly sent me a note explaining his comments. From his note and the paper referred to above, it has been found that his comments are based on the following:

(1) His enquiries from the fish merchants exporting fish to Bombay showed that the fish known as 'Palwa' in Madhwad is called 'Bhing' in Bombay, where the term is used for *H. toli* only.

(2) Palwa specimens obtained from Madhwad were identified by him as *H. toli*. This was also personally verified by him.

(3) Dr. Moses in his paper entitled 'A Statistical Account of the Fish Supply of Baroda City' (*Bull. Dep. Fish. Baroda*, 3) has mentioned Palwa as the local name of *H. toli* in Baroda (*not* Kodinar).

(4) Inspection of parcels arriving in Bombay from Madhwad etc. after the monsoons has shown that *H. toli* is more numerous than *H. ilisha,* while in the statistics presented by me *H. ilisha* is shown as more numerous.

Dr. Moses in his Check List of the Fishes of Baroda State (*Ann. Rep. Dep. Fish. Baroda*, 1937-38), gives Palwa as the local name of both *H. ilisha* and *H. toli*. In Dr. Kulkarni's paper also mention is made of the fact that the vernacular names are often interchanged. In the ports of Kodinar fishermen from different parts of Gujerat camp for fishing during the fishing seasons, and it is likely that the vernacular names used by the fishermen also vary. My information is based on personal enquiries made from fishermen and Customs staff of the area. The fish called by them as Palwa was identified by me as *H. ilisha*. Specimens of Palwa were sent to Dr. K. K. Nair who was working on Hilsa and he also identified them as *H. ilisha*. My enquiries from the local Customs staff indicated that *H. ilisha* is considered as Palwa in their records. In view of this and the observations of Dr. Kulkarni, it would appear that, as in certain other centres, there is some confusion in the use of the vernacular names of these fishes in the Kodinar ports also. So, it may not be possible to obtain the correct export data of these fishes from Kodinar by merely interchanging the figures as suggested by Dr. Kulkarni.

ZOOLOGICAL SURVEY OF INDIA,
INDIAN MUSEUM, CALCUTTA,
August 30, 1951.

T. V. R. PILLAY

18. A NOTE ON THE EGGS AND THE FIRST STAGE LARVA OF *HIPPOLYSMATA VITTATA* STIMPSON[1]

The brightly coloured shrimp, *Hippolysmata vittata* Stimpson was frequently seen among the fouling organisms of Pearl Oyster cages at Krusadai. Most of those obtained in the months from July to October were berried and in each individual specimen examined there were between 400-500 eggs. Eggs showed four different stages of development; and more than one stage was noticed on one individual.

Stage I.—Perhaps the earliest stage in development; the eggs had a rounded shape with a diameter of 0.391 mm.

Stage II.—Eggs had become ovoid and the longest diameter was 0.529 mm.

Stage III.—Slightly more advanced than the previous stage. Eggs, though oval, were bigger (0.690 mm.). The bent body of the embryo could be distinctly seen within the egg membrane.

Stage IV.—The embryo in the process of straightening out; it measured about 0.690 mm., the length of the entire egg being 0.920 mm.

First stage larva:

Some of the berried individuals were left in an aquarium for observation. The larvae hatched out in the course of the day and the parent was observed to have undergone a moult.

Description of larva:

The length of the larvae varied between 1.9 and 2.0 mm. The eyes are sessile and the carapace has a slender rostrum reaching beyond the antenullar peduncle. The abdomen has 5 segments with a pair of spines at the posterior margin of segment 5. The triangular telson has 14 spines on its margin.

Antennule: Peduncle is unsegmented; outer flagellum with a short plumose seta and 4 aesthetes. Inner flagellum absent, a short plumose seta arising in its place.

Antenna: Flagellum is small and carries a long plumose seta. Scale with 4 segments and carries 10 setae on the inner margin and tip; and 2 setae on the outer margin.

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[1] Published with the kind permission of the Director of Fisheries, Madras.

Maxilla I. Palp is unsegmented; and has 2 inner and 3 terminal setae.

Maxilla II. Endopod is unsegmented and has 6 inner marginal setae and 3 at the tip. Scale has 5 plumose setae, all of them being large.

Maxilliped I. Endopodite with 4 segments provided with 3, 2, 1 and 2 setae respectively. Exopodite has 1 outer and 3 terminal setae.

Maxilliped II. Endopodite 3 segmented, having 5 terminal setae. Exopodite has 3 terminal and 3 pairs of lateral setae.

Maxilliped III. Endopodite is long and 3-jointed. Exopod has 3 terminal and 4 pairs of lateral setae.

Menon (1940) described the larvae of *Hippolysmata* sp. from Madras plankton. Differences noticed in the characters of the larva recorded by him and those of *Hippolysmata vittata* are as follows:—

(*a*) The pterygostomial spine and the 3 small teeth observed on the lateral margin of the carapace of the larva of the species examined by Menon were absent in the larva of *H. vittata*.

(*b*) Endopodite of Maxilliped I has 4 segments each armed with 3, 2, 1 and 2 setae respectively. The Madras species though also possessing a four segmented endopodite has 3, 1, 2 and 3 setae.

(*c*) In Maxilliped II of the larva of the species described now, exopodite has only 3 terminal and 3 pairs of lateral setae, while the species described by Menon has 3 terminal and 4 pairs of lateral setae.

(*d*) Exopodite of Maxilliped III of the Krusadai species has 4 pairs of lateral setae, while the species recorded from Madras has 6 pairs.

The larva of *H. vittata* differs from the description of the larva of *Hippolysmata* by Gurney (1937) in the absence of the carapace with supra orbital spines and denticulate margin.

I am grateful to Messrs. K. Chidambaram and M. Krishna Menon for their valuable suggestions in the preparation of this note.

Krusadai Biological Station G. K. KURIYAN
Pamban.
January, 1951.

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[A detailed diagram of the larva of *Hippolysmata vittata* will be found in the paper on the Decapod larvae of Madras Plankton (reference 2 above). The difference in the larvae as described in the note and that by Menon apparently consists only in the number of setae present in some of the appendages.—Eds.]

19. BUTTERFLY MIGRATION IN THE NILGIRIS

Just before the onset of the north-east monsoon I have seen thousands of butterflies passing over the bungalow, which is at an elevation of 5,800 ft. As soon as the day begins to get warm, about 9 a.m., a few butterflies are seen coming up the valley in front of the bungalow. Soon they are arriving in thousands, all from the same direction, north to south, and all seem to be the same species, a brown butterfly with vivid blue spots all over the wings [probably *Danais limniace mutina*—EDS.] This flight takes about three hours to pass over; the same thing is seen for three or four consecutive days. These butterflies keep at a fairly high level, 8 to 10 feet above the ground.

Last year about 25th October or just before the south-east monsoon was due, the butterflies came from a different direction, east to west: the first time I have noticed them coming this way, and a different butterfly too, mostly white with a black spot [*Catopsilia pyranthe*[1]—EDS.] This flight kept much lower, skimming the tea bushes, rising rapidly over any obstacle, falling again to the low level. It resembled the previous flights in the huge quantities, starting as soon as the day became warm, continuing for about three hours, and for about three or four days. Standing in their pathway one seemed to be in a snowstorm!! We have never seen such huge quantities of butterflies at other times of the year. One wonders why they do not come before the south-west monsoon, also, why they are not attacked during flight by birds, and never do we find dead or exhausted butterflies in the garden.

On three different occasions we have seen butterflies resting at night, like a swarm of bees, hanging from the branches of trees in huge clusters. Twice we have seen them on *Erythrina*, once on *Grevillia* trees.

CURZON ESTATE,
KOTAGIRI, NILGIRIS,
S. INDIA, *April* 2, 1951.

MARGARET VILLIERS BRISCOE

20. A SHORT NOTE ON THE *EUGENIA* LEAF CATERPILLAR *CAREA SUBTILIS* WLK.

(*With a text figure*)

Carea subtilis Wlk. belongs to the family Noctuidae and members of this family are popularly known as owlet-moths. The larval stages are generally smooth-bodied, and a majority of them are leaf-feeders, with the exception of a few borers. The species *Carea subtilis* Wlk. has a few interesting features in form, habits and life-history. The following is a brief note on the observations made at Coimbatore during the past two years.

Host Plant.

The caterpillar occurs on the foliage of *Eugenia jambolana*, and has been recorded from India, Ceylon, Andamans and Java. Its distribution in South India was first mentioned by Ramakrishna Iyer (1913) along with a parasite *Tumidicoxoides jambolana* Gir. The only other alternative host recorded is *Ficus* sp.

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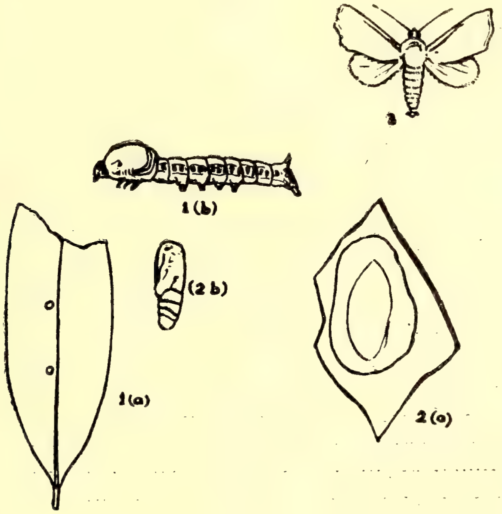
[1] Identification confirmed by the author from coloured illustrations accompanying Williams's 'The migration of Butterflies in India'—*J.B.N.H.S.*, XL, 439.

The Moth.

The adult is stout-built and sluggish during day time. The antennae are ciliated, the eyes black and conspicuous, and the wings and abdomen coloured brick red or brown, with a whitish patch. (Fig. 3). The species has been described in detail by Hampson (1896) and by Moore (1892).

Economic importance.

Eugenia is one of the fruit trees growing in nature and planted often as an avenue tree. It has seldom been recognised that the tree is subject to the infestation of not less than a dozen insects of which *Carea subtilis* Wlk. is the most important, capable of defoliating the tree severely during certain years. In the orchard at Coimbatore, it was found to occur in large numbers during March to May in the past two years.



Stages of
Eugenia leaf caterpillar
Carea subtilis Wlk.
1 (*a*) A leaf showing eggs on it
(*b*) A full grown caterpillar
2 (*a*) Cocoon on a leaf
(*b*) Pupa
3 Moth

Life history.

The moths copulate on the next day after emergence and the female lays her eggs singly on the ventral surface of the leaf all along the margin and just below the mid-rib portion on the dorsal side. An individual is capable of laying about 105 eggs and a single leaf may have from 20 to 30 eggs. The bulk of the egg laying is completed within 2 days. The larvae hatch out in three or four days. The newly hatched caterpillar is very active from the second day and even at this stage of growth it shows the characteristic swelling of thoracic region faintly with two black bands on the abdomen. It feeds on tender as well as old leaves, becomes full grown in 20 to 24 days and constructs thick cocoons of whitish silk and pupates inside. The pupal period varies from 8 to 12 days. Thus the whole life-cycle from egg to adult takes 31 to 40 days.

Egg.

The egg is oval, flattish, yellowish, translucent, without any covering and seen mostly on the edge of the leaf margin (Fig. 1*a*).

Larva.

The newly hatched caterpillar is about 1.5 mm. long and found scraping the green matter on leaf, near about the place of hatching. The notable feature about this caterpillar is that it has a characteristic prominent swelling on the thoracic region and presents a grotesque appearance. The protuberance is spongy, smooth, shining and coloured greenish above and smoky at sides. The three pairs of thoracic legs are short and strong but completely hidden by the swelling above. The five pairs of prolegs are longer and stouter and provided with strong hooks to have a firm grip on the branches and leaves of the host plant. The larva, young and old, have the queer habit of spurting out thick yellowish fluid when disturbed or handled. In nature, it exhibits also a tendency to migrate from branch to branch either in search of fresh food or of suitable site for pupation. Just before moulting, the caterpillar remains motionless on the leaf, having ceased feeding. The actual process of moulting is effected by the head shield being first pushed forward by the formation of fresh growth below, and getting detached gradually. This is followed by the rupture of the outer skin all along the body and the caterpillar emerges out of the larval skin.

The full grown caterpillar measures more than an inch. The head is small and inconspicuous, being overshadowed by the thoracic protuberance. Abdominal segments are soft, yellowish with a smoky brown tint, on the dorsal region, the sides and over the last segments. The ventral side is pale white in colour. There is a short anal horn on the 8th segment as is found in bombycid or sphingid larva [Fig. 1 (*b*)].

Pupation.

There is a drastic contraction of the size, during pupation, the bulbose swelling being reduced considerably. Thorax is seen clearly three segmented only at this stage with a clearly marked prothoracic shield. The abdominal portion has a green patch on the dorsal side with a whitish blotch on either side, while the lateral regions develop a reddish tinge. Unlike many other noctuids, it pupates on the leaf within a thick whitish silken cocoon inside either a partially or completely rolled up leaf.

Pupa.

The cocoon is attached to the leaf (Fig. 2*a*) and often two or more of them are found in one and the same leaf. The pupa is oval, reddish brown, measuring about 0.6″ in length, [Fig. 2 (*b*)].

Remedial measures.

The caterpillars which are easily distinguished, can be readily collected off and destroyed in the small plants and trees. Being an external feeder, stomach poisons may easily bring about the destruction of caterpillars. In laboratory trials 5% dusts of DDT and BHC have shown a high degree of mortality, and it is well worth a trial on field scale.

Conclusion.

Eugenia yields nutritious fruits, which is generally a delicacy of the poorer classes. Now that the tree is being freely propagated in the intensive drive for planting trees, especially those of economic importance, a detailed study of the pests infesting this tree is well worth the trouble.

MADRAS AGRICULTURAL
DEPARTMENT

K. R. ANANTHANARAYANAN,
B.A. (Hons.).
S. VENUGOPAL,
B.SC. (Zool.), B.SC. (Bot.).

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21. A NOTE ON THE BLOOD-SUCKING *SIMULIUM* OF CEYLON

The Simuliidae are a family as yet little known as far as the Ceylon forms are concerned. As far back as 1912, Mr. E. Brunnetti described a new species of blood-sucking fly from Peradeniya (altitude 1,500-1,600 ft.). He named the new species *Simulium striatum* which is the first *Simulium* to be known from Ceylon. The only other record is by Mr. R. Senior-White who captured a single specimen of *Simulium grisescens* hitherto known from a unique male from Kurseong, on a window at Suduganga in the Matale District in January 1920. Thus only two species of *Simulium* are recorded as found in Ceylon.

During the beginning of June this year, when collecting insects in a rather woody patch of jungle at Horton Plains (altitude 7,000 ft.) in the Nuwara Eliya District, I was severely bitten on the forehead and also on the back of my neck and ears by a few small black flies. I recognized these little insects as belonging to the dipterous family Simuliidae. I was fortunate to secure two specimens in the act of biting me and sucking blood, and they are definitely determined by me as *Simulium* which, I believe, to be a hitherto unrecorded, or possibly a new species from Ceylon. The bite of these blood sucking *Simulium* can be described as sharp and stinging, and within a couple of hours resulted in the development of a hard lump or swelling which persisted for a number of days. In fact the bite is definitely far more painful than that of a mosquito, and resulted after a couple of days in the formation of irritable spots, which eventually went on to ulceration. A week later however, the swelling increased considerably on the face and neck, forming an enlargement of the gland on the right side of the neck. The affected areas gave me much pain and inconvenience, and of course ultimately I was compelled to seek medical aid and treatment for suspected toxic symptoms.

It is of interest to note that this particular blood-sucking *Simulium* from Nuwara Eliya District is so similar both in its bite and superficial appearance to the well known 'Potu' fly (*Simulium indicum*) from the north-west Himalayas that it is very closely allied to this form. A technical description of the female of this species by Dr. Edward Becher was published in the *Journal of the Asiatic Society of Bengal* Vol. liii, Part 2, pp. 199-200 (1884). There is an interesting note on the 'Potu' fly as found in the Himalayas by Mr. E. C. Cotes in the *Indian Museum Notes* Vol. iii, No. 5, pp. 39-41 (1894), which is followed up by yet another important note on the blood-sucking habit of this fly by Mr. Lionel de Niceville in the *Indian Museum Notes* Vol. iv, No. 2, pp. 54-55 (1896). From all that is known of the habits of European and American species of this genus it is supposed that the female lays her eggs in quick flowing hill streams, and the larval and pupal stages are passed in the water. The two specimens captured by me at Horton Plains (altitude 7,000 feet) Nuwara Eliya District in June 1951, are both females with mouth parts developed for blood-sucking. The male is believed to be a harmless insect with rudimentary mouth parts.

ENTOMOLOGICAL LABORATORY,
NATIONAL MUSEUMS OF CEYLON,
COLOMBO 7 *July* 25, 1951.

T. R. SANDRASAGARA,
F.R.E.S.

22. MATING BEHAVIOUR OF LEECHES

One April afternoon in the Anamallais I was laying on the ground watching ants at work when my attention was drawn to gentle tapping noises coming from some foliage nearby. I looked up and saw a leech tapping a leaf. There were answering taps some distance away. Shortly afterwards a male leech came into view and landed on the same leaf as the female and both tapped the leaf together and separately. I should say this lasted for a good two minutes. The male then approached to within ¼" to the female and the dance started. They tapped the leaf and the heads curled round one way and then the other way interrupted by both tapping, sometimes once and sometimes twice, always together. This tapping and embracing continued for another two minutes. The male organ then projected and they coupled. Together they moved backward and forward leaning over one way and then the other. I should say this went on for 1½ minutes. After completion, the male went off the way he came and the female in the opposite direction.

KADAMANE ESTATE & P.O.
HASSAN DIST., MYSORE.
July 25, 1951.

C. J. LESLIE

[By way of comment on the above, Dr. C. Brooke Worth quotes from Craig and Faust, 'Clinical Parasitology', Philadelphia, 1940, the following:

> P. 493. 'Leeches are hermaphroditic. Each worm possesses 1 to 10 or more pairs of small, hollow, spherical testes. A small vas efferens, arising from each testis, enters one of the paired vasa deferentia, which continue as paired seminal vesicles, each being usually provided with a prostate gland, an ejaculatory duct and a muscular penis. The two ejaculatory ducts enter a common bursa copulatrix or genital atrium. The ovaries consist of a single pair of coiled, filamentous sacs which are continuous with their ducts. The two ducts unite to form a common convoluted oviduct, which is continued as a muscular uterus and opens through a short vaginal tube in a mid-ventral line, one metamere behind the male genital opening (usually stated to open on somite 9).'
>
> P. 494. 'In some leeches insemination is accomplished when one leech implants onto the cuticula of another a horny pocket or spermatophore, from which spermatozoa issue forth, migrate through the tissues of the recipient and reach its ovary. In the group to which the medicinal leech (*Hirudo medicinalis*) belongs, reciprocal copulation takes place by the introduction of the penis of each into the vagina of the other and the reciprocal deposition of a spermatophore. Thus, in either type, fertilization takes place before the eggs are layed.'

He agrees that Mr. Leslie's observation is of interest, for the witnessing of mating behaviour of leeches must be a rare, if not unique, occurrence. One is tempted to guess that the leeches' antics served as recognition signals to bring them together for copulation.—EDS.]

23. DESCRIPTION AND DISCUSSION OF THE BITING OF AN INDIAN LAND LEECH (ANNELIDA; HIRUDINEA)

In the literature at hand embracing medical parasitology there is no detailed description of a land leech's biting. Hence it may be of interest to record experience arising out of curiosity about this matter.

Craig and Faust (1) give information that indicates *Haemadipsa zeylanica* as the common land leech of Southern India. Leeches corresponding in size (about 1 inch long) and somewhat in behaviour to this species are common on coffee and cardamom plantations in the western part of Mysore State, especially in the monsoon period during the summer months. The present observations were made near Sakleshpur, Hassan District, in the Western Ghats during June-August, 1951.

A word should be said first about the method by which these leeches reach a host. In Craig and Faust and in Manson-Bahr (2) is found the statement that terrestrial leeches 'actively spring' upon their victims, while Strong (3) recounts the opinion that *H. zeylanic* may at times 'drop' onto hosts from overhanging vegetation. While neither of these methods of attack has been observed in Mysore, the second can be imagined as possible, but the first cannot be classified as otherwise than fantastic. Leeches have light receptors but no visual organs, for registering images, so that the presence of a potential host in their vicinity could be realised by them only as a vague phenomenon. Leaping, if it took place, would be random and ridiculous. Secondly one wonders just how a leech would manage a leap, since its locomotor organs consist solely of the anterior and posterior suckers, structures that are hardly adapted for jumping.

Dropping onto a victim entails the necessity again for accurate awareness of the position of a passing host. Perhaps the jostling of vegetation would provide sufficient stimulus to spark the dropping manoeuvre. But so far as Mysore observations are concerned, the unfed leech is loth to detach itself from whatever substrate supports it. Locomotion, even by the hungriest leech, is accomplished by a succession of looping motions, resembling those of a measuring worm (Lepidoptera; Geometridae). The hind part of the body is brought forward when the anterior-sucker has found agreeable attachment; the fore part is extended when the posterior sucker is similarly satisfied. Thus final lodgement on a host results from initial awareness of the host's presence and resultant crawling activity in the host's direction. The fact that coffee planters and other bucolic inhabitants have a motto, 'Walk first in line,' is a testimonial not to leaping or dropping of leeches, but to leeches' awakened activity when the first man passes, leading to infestation of individuals subsequently traversing the disturbed path.

Land leeches may be encountered or collected when one walks through damp ravines or similar moist situations. They frequently are detected first on one's shoes. If it is desired not to permit them to feed, one naturally tries to remove them and throw them away. This is about as easy as trying to rid one's fingers of a wad of chewing gum that has begun to stick. The leech's leathery or rubbery integument seems almost insusceptible of injury, and even rough treatment, from hand to hand, does not dissuade the worm from fastening itself by one sucker or both to each new grasping forefinger and thumb.

The leech on a shoe, or on a stone or rotted leaf near its prospective host, progresses by a series of looping motions. Each time the posterior sucker is brought forward to a new position, the anterior part of the body is elevated and goes through a rapid vibratory groping motion which could be likened to the sniffing of a dog determining the direction of its quarry. Whether this is a search merely on a tactile basis, or an actual olfactory experience, cannot be assessed.

When a leech is placed purposely on the back of one's hand, in order to observe it conveniently through a lens, it quickly avails itself of the opportunity to feed without disturbance. The anterior sucker is apparently some sort of testing or tasting mechanism, for the leech is not always satisfied with the first spot encountered. However, one or two looping steps usually suffice to bring the animal into feeding frame of mind.

Immediately when the leech finds a location suitable for feeding, the human subject may feel a slight stinging or irritating sensation. This lasts for half a minute or less; were the observer engaged in other activities, the chances are that nothing at all would be noticed.

But even the intent student feels nothing more after this short initial period of minimal discomfort.

Close examination of the leech from now onward discloses that its neck is the site of rhythmic contractions and expansions. These movements consist of slight alternating dimplings of the cuticle in two regions, one behind the other. A low-powered hand lens provides sufficient magnification for observing this phenomenon. The frequency of contraction cycles is about two or three per second.

During the first five minutes there is little change in the general situation. The leech appears to draw its posterior sucker slightly forward, but this may in reality be illusion produced by its imperceptibly broadened diameter as the first blood is ingested.

For the next fifteen minutes the events attendant upon beginnings of obvious engorgement take place. Sucking motions of the neck region continue without interruption. The body becomes distended laterally and dorsovenrtally. A pool of thin liquid—not mucus—begins to appear around the leech. The nature of this liquid has not been sttudied in Mysore. However, it appears in increasingly copious amounts during the remainder of the feeding period, and the possibility suggests itself that the transudation or excretion may be a means of getting rid immediately of excess fluid from ingested blood, in order to concentrate the solid elements of that tissue. This would increase the efficiency of feeding and the subsequent possibilities for massive egg production.

In the following twenty minutes maximum engorgement takes place. Owing to the attachment of the posterior sucker in a fixed position, the body of the leech is pushed forward over its head, leading to an undershot position of the anterior sucker, and the bending of the leech's neck into S-shaped curve. The distortion becomes increasingly marked as feeding progresses to its completion.

When engorgement becomes advanced, a series of irregular peristalic contractions of the body begins, the waves of contraction moving in general from before backwards, although being by no means uniform. This must serve to put the ingested blood through a churning action, and also to distend the paired lateral pouches of the crop in which food is stored, thereby possibly making room for the imbibing of more nutriment.

Just before voluntary detachment, the leech exhibits maximal peristaltic activity, while the surrounding pool of 'leech fluid' becomes also most voluminous. Detachment takes place during an exhibition of peristalsis, as if the worm were still reluctant to let go, but in its bloated and unwieldy condition were unbalanced by the violence of its somatic activities.

The site of attachment, viewed through a lens and through 'leech fluid' at the instant of release, resembles a geometric three-cornered star, aptly described as a triradiate wound (1). The cut edges are wonderfully neat and symmetrical. Owing to prolonged sucking action of the leech, the edges are now slightly edematous and therefore elevated, with separation of apposite margins.

Blood immediately diffuses into the leech fluid. However, the present observer experienced only slight subsequent bleeding. After wounds were wiped once or twice with a handkerchief, clotting took place and an insulating crust was formed. This is not in accord with most reports, in which the lesions are said to bleed 'for sometime' even after voluntary detachment of the leeches (3).

Later reactions to leech bites in the present instance have consisted of: (*a*) Visualisation of the triradiate lesion (under magnification) for eight hours following the bite. Hemorrhagic infiltration of the surrounding skin was evident within the edematous area corresponding to diameter of the leech's mouthparts (under 2 mm.). (*b*) Itching of the bite site was noted for several days.

The engorged leech, on relinquishing its hold, encounters difficulties in locomotion, since it is now so greatly distended. It shows no hesitation in dropping to the ground, which must be a rather uncomfortable experience for a worm with a full stomach. Upon reaching such environment, it continually falls over to right or left, since its pot belly interferes with easy progress. The anterior end apparently still functions as a sense receptor, apprising the organism of the state of local conditions. Thus the leech succeeds at last in dragging itself to the edge of a pebble, beneath which it secretes itself within a few moments.

No. 3, St. Marks Road, C. BROOKE WORTH
Bangalore, Mysore.

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24. A TERATOSIS OF *MUSSAENDA HIRSUTISSIMA* HUTCH

A striking teratosis of *Mussaenda hirsutissima* has been found in the High Range of Travancore which seems worthy of record.

The species is common in the area and is very conspicuous on account of its bright orange red flowers and the occurrence of a greatly enlarged sepal on some of the flowers which is white in colour and roughly of same size as the leaves. The enlarged sepal is by no means regularly formed. In a series of inflorescences of from 8-21 flowers, not more than 3 or 4 show this development in each inflorescence.

In the abnormal plant, the frequency of the enlarged sepal is similar to that in the normal type, but every corolla is replaced by 5 separate 'petals' of the same form and colour as the enlarged sepal. The stamens are represented by short hairy subulate staminodes. The ovary is 5-locular, instead of the normal bilocular, and the usual single style with a bilobed stigma is replaced by 5 separate style-like organs considerably shorter than the normal style, which do not appear to have functional stigmas.

Two plants of this type have been found both within a few yards of each other, but separated by a metalled road, in association with a number of quite normal individuals. Although the species is very common in the district, occurring in small societies, no cases of this abnormality have yet been seen in any other site so far examined.

SCIENTIFIC DEPART. W. WILSON MAYNE
MUNNAR, TRAVANCORE
June 25, 1951.

25. *FREREA INDICA* DALZ.—A NEW RECORD IN BOMBAY

After the publication of my previous note on the occurrence of this plant in Purandhar in this journal (49: 801-802, 1951) I received a letter from the Rt. Rev. R. D. Acland, M.A., formerly a vice-president of our Society, in which he states: 'My Cooke shows from a marginal note that I had *Frerea indica* at Kate's Point, Mahabaleshwar, in October 1924. It may well be there still; do look for it. I did not note the exact date but was there for the first three weeks of the month; still in the clouds for the first day or two. I always regretted never having got there in October again . . .'

Mahabaleshwar, then, must be counted among the few localities in our State where this very rare plant has been observed in recent years.

ST. XAVIER'S COLLEGE, H. SANTAPAU, S.J.
FORT, BOMBAY 1.
July 30, 1951.

26. A BRANCHED SPECIMEN OF *COSTUS SPECIOSUS* SMITH

Costus speciosus Smith is a very common plant all over the area of the National Park at Borivli; the appearance of the plant, however, is very typical, and the present is the first branching specimen that has come to my notice. The stem is normally spirally curved, with large leaves placed spirally on it; the usual size of the leaves may be about 15—20 x 8—10 cms., and leaves cover the whole stem from below.

On June 30, 1951, a plant was seen in a clump of normal specimens showing remarkable structures. The lower part of the stem was leafless up to about 75 cms. from the ground, and perfectly straight; at about that height there were four small branches, each of about 15 cms. in length. These small branches were covered with leaves of only 5—8 x 4—5 cms., all placed in the usual spiral fashion on each branch. On careful examination it was noticed that the stem had been damaged at the apex, and this may have induced this strange proliferation.

On the hills near Bombay there is another plant that is usually unbranched, or very sparingly branched; it is *Buchnera hispida* Buch. Ham., of the family Scrophulariaceae. On several occasions I have observed the plant branching profusely from near the ground, but on examination it has been found that the main stem had been damaged by browsing animals. The case of *Costus speciosus* Smith described in this note seems to be a similar one, and requires no further explanation.

ST. XAVIER'S COLLEGE, H. SANTAPAU, S.J.
FORT, BOMBAY 1.
July 4, 1951.

27. A NOTE ON *NEURACANTHUS SPHAEROSTACHYUS* DALZ.

(*With two plates*)

During many botanical excursions in the neighbourhood of Bombay, the authors of this note have been frequently struck by the abundance of this plant. If Dalzell and Clarke are correct in their statements that this plant seldom sets seed, such an abundance is almost unintelligible. For this reason we have paid particular attention to the habits of this plant with a view to elucidate an apparent contradiction.

Before describing the plant, it may be worth putting down its synonymy and calling attention to an error in Cooke's Flora concerning the spelling of the specific name. Cooke writes: *N. sphaerostachys*; Dalzell always called the plant *N. sphaerostachyus*, and so did Clarke in Hook. f., Flora of British India. Cooke's spelling must be considered a simple printing error. The synonymy is as follows:

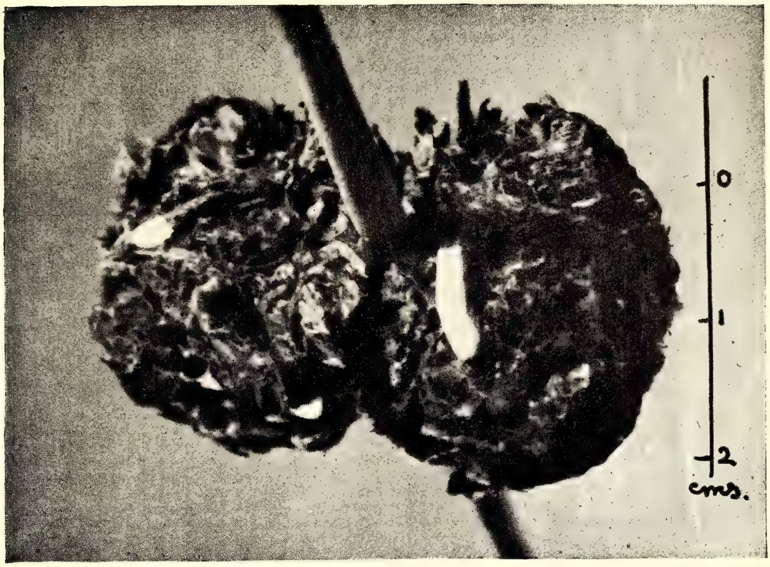
Neuracanthus sphaerostachyus Dalz. in Kew Journ. Bot. 2: 140, 1850; Dalz. & Gibs., Bombay Fl. 190; Clarke in FBI. 4: 491; Cooke, Fl. Pres. Bombay 2: 387 (*sphaerostachys* per sphalm.).
Lepidagathis sphaerostachya Nees in DC., Prodr. 11: 254, 1847.
Neuracanthus lawii Wight, Icon. t. 1531, 1850.

Before giving our own observations on the plant, we may be allowed to transcribe Dalzell's description, translating it from the Latin where necessary:

'*Neuracanthus sphaerostachyus*; stems very many, erect, simple, obtusely quadrangular, pubescent-scabrid from a perennial root; leaves opposite, oblong, truncate at the base or subcordate, apex obtuse, both sides of the leaf pubescent-scabrid, pale beneath, spikes in opposite axils, sessile, capitate-congested, globose, densely silvery tomentose, growing much after anthesis, bracts orbicular, suddenly acuminate, coloured, 5-7-nerved, reticulately veined, slightly longer than the calyx; upper lip of the calyx oblong, 3-toothed, 3-nerved, the lower lip deeply bifid, segments lanceolate, 1-nerved, all the segments reticulately nerved; tube of corolla slender, cylindric, as long as the calyx, limb entire, ventricosely rotate-cyathiform.—*Neuracanthus sphaerostachyus*, Dalz. in Hook. Plant. ined. with plate.

'Stems 1½-2 ft. high, at times verrucose below. Leaves 4 inches long, 2 inches broad, somewhat hard. Spikes single, turbinate, 6-12 lines long. Bracts and calyces in flower 3 lines, in fruit 9-12 lines long, enclosing the capsule, all sericeotomentose on both sides. Corolla 6 lines long; tube white, limb blue; anthers, stigma, capsule etc. entirely as in *N. tetragonostachyus*.—Grows in both Concans; flowers Sept.

'Although the limb of this singular plant is entire, it is very evidently made up of five pieces, not exactly by the union of their margins, but by the interjection, as it were, of triangular pieces, so as to unite the opposite margins. Each of the five pieces is indicated by parallel veins and lines of hairs on the back. Each piece has three veins, there being six close together in the upper part of the limb, and two lines of hairs indicating the two parts of an upper lip; the same marks are visible on the lower side of the limb at



1. Dry inflorescence

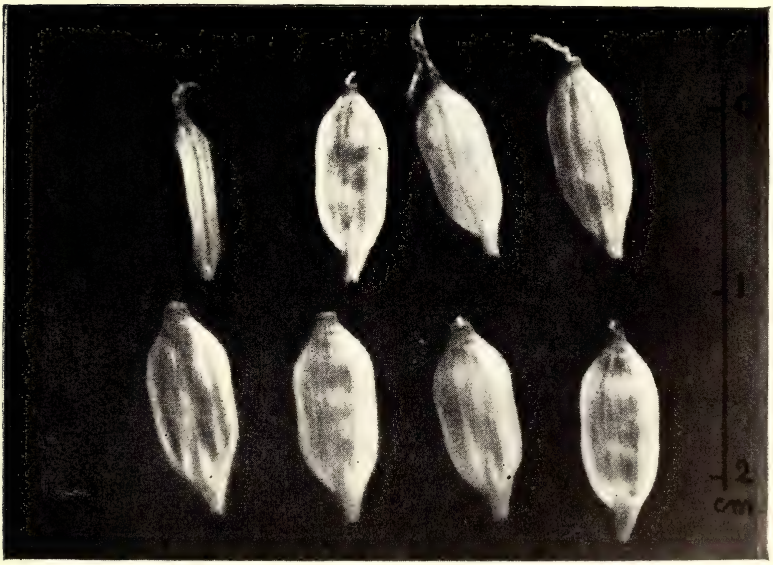
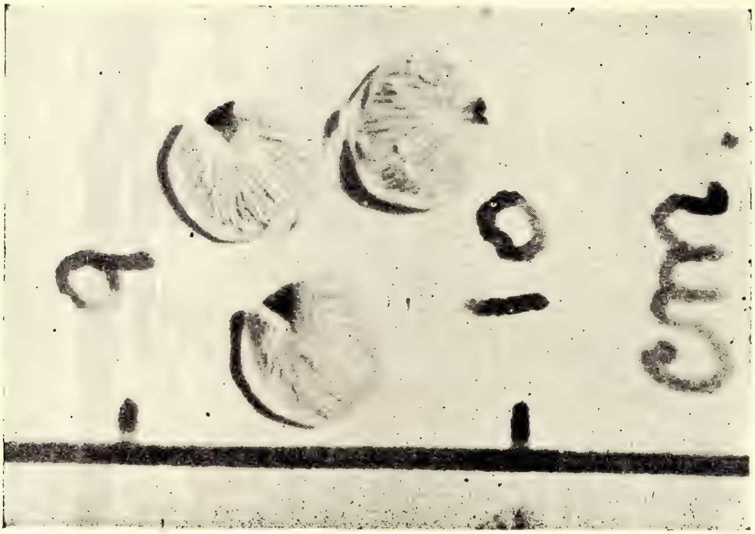
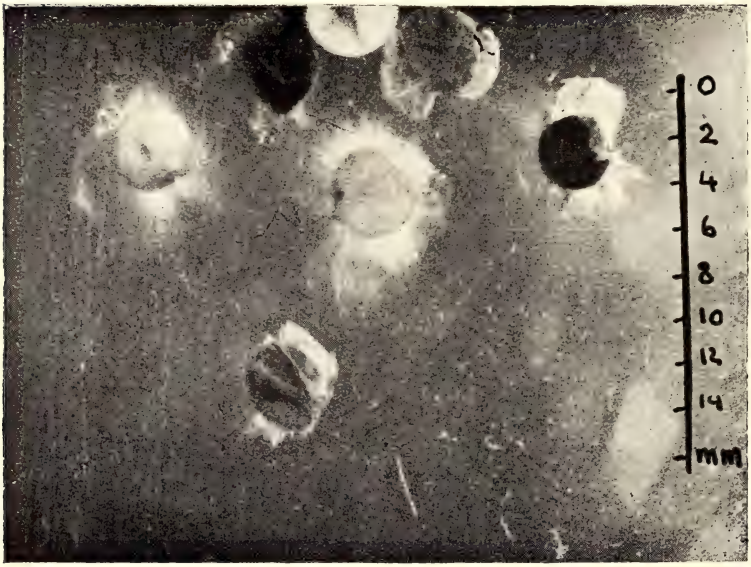


Photo *Author*

2. Mature capsules



3. Dry seeds



Photos *Author*

4. Seeds in water

greater distances from each other, indicating three divisions, the middle one being furnished with a line of hairs both outside and inside. The aestivation is decidedly plicate and not contorted.'

This is a common herbaceous to shrubby plant, found in more or less open country, gregarious, and very conspicuous especially during the dry pre-monsoon period; at such a time this is often the only plant left standing on grassy slopes or plateaus especially after the grasses have been removed by fire. At the best of times it is not an elegant plant, but during the dry season it is a veritable eyesore and a constant nuisance.

Dalzell and Cooke mention that the rootstock is perennial, but seem to imply that the stems are annual; this accords with our observations only in a general way; on numerous occasions we have noticed *old stems giving out fresh leaves* at the beginning of the monsoon season, and this seems to show that the stems, at least occasionally, are biennial or possibly perennial.

As a rule the stems are erect, simple and terete to subquadrangular, 15-75 cms. high; branching is very rare. Leaves are sessile or subsessile, up to 10 × 6.5 cms., obtuse or subobtuse, glabrous to scabrid, and generally rather stiff and rough to the touch; both surfaces are covered with numerous raphides, which are plainly visible in dry specimens; the leaf base is rounded to cordate, often distinctly unequal-sided; main lateral nerves 8-10 pairs, conspicuous. The leaves persist on the plant from about June till well into the hot season.

Flowers are generally axillary, occasionally axillary and terminal; at first in simple spikes, at length in dense heads formed of closely packed spikes, the heads reaching 7.5 or more cms. in diameter. Bracts at first green, then brown, at length black, often broader than long, the lower ones practically glabrous, the rest densely hairy and ciliate, all strongly nerved. For the bracteoles and calyx segments, see Cooke. Calyx 2-lipped, the segments 3 and 2. Corolla limb cup- or funnel-shaped, entire or nearly so, only slightly 2-lipped; the colour of the corolla limb is generally deep purple-blue or deep purple, occasionally white; the corolla tube is whitish; the diameter of the corolla is about 20 mm.

Possibly one of the reasons why some authors have failed to find fruits and in consequence have stated that the plant seldom sets seed, is that the development from ovary to fruit is very slow indeed; flowers appear at the beginning of August, and generally it is only towards the end of December or even later that the capsules appear, but even then they are enveloped in such a dense array of bracts and bracteoles as to be practically invisible; only careful search can reveal their presence during winter and the early part of the hot season. We have studied this point for several years, and invariably have found 10 or more mature capsules in well-formed heads; photo no. 1 shows an inflorescence head collected on June 15th, 1951, with 4 or more capsular valves after dehiscence. In the general conflagration of our hills that takes place during the hot season, many of the capsules, especially those placed on the outer parts of the floral heads, are destroyed by burning, but even so, numerous capsules escape destruction and come to normal dehiscence.

Mature capsules (photograph no. 2) are light brown in colour, glabrous and shining, oblong in shape, shortly and suddenly attenuated at the apex and base, flattened parallel to the septum; average dimensions about 12-14 × 4.5 × 2.3 mm. Seeds 4, two in each loculus, each seed supported on a hard, up-turned retinaculum; seeds about 4-4.2 mm. diam., 0.6-0.7 mm. thick, orbicular or nearly so, densely covered with whitish or greyish-white long hairs, which are closely appressed to the seeds; the dry seed appears to be deeply striated, but the striations are due entirely to the arrangement of the hairs. When the seed is placed in water, the hairs expand forming a sort of a corona round the nearly glabrous, light-brown seed; the size of the wet seed with its concomitant corona is up to 11 mm. diam. (see photographs nos. 3 and 4).

As soon as the first rains of the monsoon fall, the capsules dehisce somewhat explosively, and seeds are thrown some distance from the parent plant; the capsule valves remain more or less attached to or entangled in the floral head and are conspicuous (see photograph no. 1). Germination seems to take place almost at once; the two cotyledons are suborbicular in outline with 5-7 nerves from the base. Often the seeds are unable to escape after dehiscence of the capsule on account of the dense structures surrounding the capsule, and then they germinate on the parent plant.

ST. XAVIER'S COLLEGE,
BOMBAY,
August 26, 1951.

P. V. BOLE, M.SC.
H. SANTAPAU, S.J.

EXPLANATION OF THE PHOTOGRAPHS

Photo. 1: Dry floral head with remains of several capsules after dehiscence.

Photo. 2: Mature capsules before dehiscence; the top left-hand capsule is shown side-ways, the others frontways.

Photo. 3: Dry seeds photographed on a scale to show size.

Photo. 4: Seeds placed in a dish of water, with the corona expanded round the seeds.

28. THE FLOWERING OF *STROBILANTHES* IN KHANDALA (IV)

In continuation of my previous notes on this intriguing subject, here are some more data gathered during September 1951. In August 1950 I reported a fairly extensive flowering of this plant on Bhoma Hill, in Khandala; the flowering had taken place in the second half of the monsoon of 1949. Recently I examined the same spot and found that a general flowering is now in progress on the higher parts of Bhoma Hill. From the Saddle upwards to the top of the hill and coming down by the opposite side, locally known as Barometer Hill, down to about the same height as the Saddle practically every plant is loaded with buds or flowers.

Out of curiosity I examined a number of the smaller plants in flower; some of them measured only 15 cm. in height, and had up to 20 buds, i.e. not single flower buds, but whole 'strobili'; the colour of the bracts varied from pure creamy white through green to deep pink, the latter being the commonest colour. On the same small plants the number of leaves was only 2—4. Larger plants reaching up to 2 m.

or more in height, the number of 'strobili' was too difficult to count, but they were simply massed all along the plant.

In the spot mentioned in my previous communication, i.e. the NW. side of the top plateau, where a general flowering had taken place in 1949, at present I could see very dense growths of the same plant; some of the specimens were only 50 cms. high, but in the centre of each clump plants reached 1.5 m. high; all these plants were in the vegetative state only, without a single plant showing buds or flowers.

Careful examination of the district round Khandala revealed the fact that only 6 plants in all were seen in flower, scattered singly throughout the district. On the other hand the plant is very abundant practically on all the hills and slopes near Khandala down to Thakurwadi along the G.I.P. Ry. line.

The imaginary line mentioned in my previous note dividing flowering from non-flowering plants is also very clear this year, plants on the W. side being sterile, those on the E. side of the same line being loaded with flowers. For a beautiful sight I strongly recommend a day's trip to Khandala, the top of Bhoma is just a veritable riot of colour.

ST. XAVIER'S COLLEGE, H. SANTAPAU, S.J.
FORT, BOMBAY 1.
September 16, 1951.

29. PREPARATION OF A FLORA FOR MADHYA PRADESH AND THE CENTRAL PARTS OF THE INDIAN UNION

Since the issue of Hooker's Flora for the whole of India, regional floras have been prepared for most parts of India except for Madhya Pradesh. Such floras are:

Cooke—Flora of Bombay (1901),
Haines—Flora of Bihar & Orissa (1921-1925) and
Gamble (Fisher)—Flora of Madras (1914-1935).

In the M.P. the only partial lists prepared have been H. H. Haines's 'List of Trees, Shrubs and Grasses for Southern Circle', D. O. Witts's 'List of Trees, Shrub & Grasses of the Berar and Northern Circles', and Graham's 'List of Common weeds found in and around Nagpur'. No herbarium has been formed in any institution in M.P. though some small collections exist in the Nagpur University and the Balaghat Forest School.

2. Therefore anyone undertaking botanical work in Madhya Pradesh is very greatly handicapped in prosecuting his studies. For my part I travel with the Bombay, Bihar and Madras floras and I have to consult one after the other to track down some species. For instance in Chanda and South Bastar many plants are described only in the Madras flora; in east Madhya Pradesh, the plants are mostly found in the Bihar flora, while in central and west Madhya Pradesh the Bombay flora is more useful. The further disadvantage is that these floras were prepared 15-50 years ago and in many ways are getting out of date, or are out of print.

3. In addition the whole scientific attitude to systematic study of living organisms is changing; and, in particular, in plants it is realised that the old attempt to allot every specimen to a definite

species is impossible. We find every gradation and a more flexible nomenclature is needed. It is, therefore, a suitable time to undertake an entirely new flora for the central parts of the country.

4. The area of country to be covered by the flora would have to be decided first. In this connexion we must look ahead to the possible formation of linguistic provinces. The present territories included in the Madhya Pradesh State vary in altitude, rainfall and rocks, but the similarities are greater than the differences and the present State (excluding certain outlying parts) is a satisfactory botanical unit.

5. The organisation of the work would have to be discussed by the parties concerned and the amount of detail to be given in the Flora. Modern botanical studies pay as much attention to the ecology of the species as to its identification. It appears desirable to extend the scope of the flora beyond the usual. In that event the first steps to be taken are to organise the formation of an herbarium where all the specimens collected may be housed and final and authoritative identification done; secondly, to obtain records of the distribution of the plants within the area covered by the flora and thirdly, to record information on the soils on which each plant is found growing, altitude, time of flowering, fruiting and relative abundance or scarcity. I would estimate this preliminary work would take at least five years. In the past there were enthusiastic and learned men like Haines, Gamble, Fisher, Kunjilal and Mooney to do all this work themselves, but none such are available now. However, each year a large number of graduates in botany pass out from the colleges and a number are now working in the Forestry Service and there may be an equal number in the Agricultural Department. What we lack in knowledge may be made up in numbers. I am sure that if the local botanists know that the preparation of the flora is being undertaken they will also co-operate to make the initial collections to form a basis for the final compilation.

6. There is the further question of the headquarters for such an organisation. It would be best if it could be housed either in the University or the Nagpur Museum. However, as funds would be small it may be necessary in the first place to rely on voluntary workers. Later, funds would have to be arranged by the Government for the printing and publication.

7. Another important principle is that of language. All the existing floras are in English and it would be very tedious and awkward to translate any of these into the State language. A flora printed in Hindi will, however, be an absolute necessity within 10-15 years, and it appears much better to prepare an entirely new and up-to-date flora in Hindi than to adopt an old one written in English.

8. Accordingly, I am venturing to place these facts before the various heads of departments in the Madhya Pradesh administration and the Vice-Chancellors of the Universities. I request the heads of departments to forward the Memorandum to the Hon'ble Minister in charge of the departments with their comments. I hope the Madhya Pradesh Government would consider the scheme worth investigation and would agree to summon a conference to be attended by all the interested parties in the near future. I have hopes that the

preparation of a Flora for Madhya Pradesh would be a worthy project to include in the next five-year development plan for this State.

9. Though I visualise in the first place that the work would be carried out mostly by voluntary workers, there is no doubt that a special 'State Botanical Survey' should be set up. This would be in the long run the most economical and efficient way to carry out the work. This survey could be either a separate department like the Geology and Mining Department or could be attached to one of the existing departments such as the Agricultural or Forest Department.

JAGDALPUR,
BASTAR,
October 1, 1951.

C. E. HEWETSON
Conservator of Forests

30. SHOOTING OF PEAFOWL AND ANTELOPE (BLACKBUCK) PROHIBITED IN MADRAS STATE

From Madras Information 5 (7): 34, *July* 1951.

'It is brought to the notice of Government that the Indian Blackbuck usually found in open rural areas in the districts of Chittoor, Bellary, etc., and the peacock found in large numbers in the district of Bellary and especially in the Sandur area are being ruthlessly decimated in numbers of reckless shooting of premature males and pregnant females. With a view to prevent this reckless shooting of these vanishing species, the Government of Madras have under the powers vested on them by Section 3 of the Wild Birds and Wild Animals Protection Act, 1912 (Central Act VIII of 1912), declared the whole year to be a close time throughout the State for Peafowl (which includes peacock and peahen) and antelope (blackbuck).'

R. W. BURTON
LT. COL., I.A. (Retd.)

31. GLEANINGS

Without comment

'Many a native tractor driver, leaving his machine in a field overnight, returned to find a tiger sleeping in the driver's seat'.

(From an account of the use of American tractors in India—*Time* dated 2nd July 1951, p. 23.)

A Super Builder

A South African Weaver Bird (*Ploceus ocularis*) has been known to build a nest with an entrance tube 'upwards of 8 feet long'.

[Friedmann: 'Breeding Habits of Weaver Birds'. Annual Report of the Smithsonian Institution (1949) p. 295.]

Pantocrin from deer antlers

The following is from an article entitled 'In the Altai Highlands' in Soviet News No. 1 of March 1950, p. 32.:

'Not far from the road lies a big maral-breeding state farm. The marals—a big, handsome species of deer—live in natural conditions, at full liberty. A high wall prevents them from leaving the territory of the state farm, which comprises 7,500 hectares of forest land.

Every spring the grown stags are separated from the herd and rounded into a special enclosure, where, one by one, they are driven into the antler-cutting pen. A few strokes of the surgical saw, and the young antlers, still soft, have been removed. Next spring they will grow again.

The medicinal qualities of panti, or antlers, have long been known in Tibetan medicine. The true source of these qualities, however, was discovered only in recent times by Soviet research workers.

The secret lies in a substance known as pantocrin, remarkable for its tonic qualities and its acceleration of the healing of wounds and ulcers.

The Soviet pharmaceutical industry produces pantocrin from antlers in sufficient quantity to allow its extensive application in medical practice.'

[Maral is the Eastern Red Deer (*Cervus elaphus maral*).—EDS.]

Cobra feigning death

Wesley H. Dickinson in *Herpetologica* 1948, p. 147, has a note on an Egyptian Cobra *Naja haje* that appeared to be dead in a cage. He writes:

'I removed it and noted that the tail would hook around an object when the body was lifted. I placed it in the sun thinking that it may come to life . . . The snake's mouth hung open and it lay on its back with an unnatural stiffness. I handled and watched it for an hour without detecting any breathing, but the trachea opened slightly and irregularly. A slight evidence of life was seen from time to time so I replaced the snake in its box and placed the wire cover over it.

After ten minutes absence I found the cover off and the snake gone. After prolonged search the snake was found entering a hole in a wall. The snake was active and agile.

While placing the snake in its box I felt it go limp and apparently dead. Five minutes later it lifted the cover and started to escape, but it saw me approaching and 'froze'.

I then placed it upon its back on the cement walk. After a few minutes it righted itself and started to crawl, but upon being touched, again feigned death. This experiment was repeated several times.'

A giant teak tree of Mysore State

From the Editor's Miscellany of the *Indian Forester* for June 1951:

'Shri M. A. Muthanna, Chief Conservator of Forests, Mysore, has written about a giant teak tree felled recently in the Kakankote State forest, compt. X. The tree was 25 ft. in girth, at 4½ ft. from the ground with a clean bole of 66 ft. It has yielded 659 cubic feet of timber which at the current auction sales prices will yield a revenue of Rs. 4,613 to the State. About 680 annual growth rings were counted on the stump and it is just likely that some incomplete rings were included in the counting.'

Albino lion

Lt.-Col. J. Stevenson-Hamilton in a letter published in the *Field* dated 10th March 1951 records a friend of his shooting an albino lion. It was a female cub about 18 months old almost completely white. With the same pride was a full-grown lioness which he was unable to secure, but which he judged to be whiter than the three-parts grown cub. He further states:

'The body of the cub was dirty white, there were no body spots, no black on its ears, or above its eyes, and the tail tuft was light-straw-coloured. Its eyes were pale bluish grey, and the eyelids and lips were white, with a faint pink tinge.'

Decline of musk deer

T. H. Hawkins in a note on 'Musk and the Musk Deer' *Nature*, Vol. 166, p. 262, draws attention to the speed with which musk deer are being destroyed in China, Manchuria, Korea and other places. He notes that in 1925 the quantity of musk exported from China and Eastern Tibet was stated to amount to about 27,000 Chinese ounces per annum, valued at £100,000. The number of animals killed annually in China and Tibet at that time was estimated to be between 10,000 and 15,000.

Penetration of high velocity rifles. Vitality of elephants

John Taylor in 'Big Game and Big Game Rifles' refers to the penetration power of the .375 magnum:

'I have several times had three buffalo dead to one bullet—heart shot. But the biggest bag of all was seven eland to one shot! (An eland may weigh from 15 cwt. upwards)'

On page 38 of the same book, he says:

'I, myself, personally knew two young sportsmen who between them actually succeeded in placing forty-two shots into an elephant without bringing him down. And even after that, he was able to kill one and seriously injure the other before he himself collapsed.'

Hunza

Dr. Aggarwal, Superintendent of the Central Asian Museum at Delhi informs us that the name 'Hunza' (in north Kashmir) is derived from the Sanskrit *'Hansa marg'* meaning the path of the geese.

The Vicious Octopus

Woody Williams in 'Friend Octopus' says on page 212:

'In 1947 Don Simpson, collector for the Steinhart Aquarium in San Francisco was bitten on the back of the hand by an *Octopus apollyon*, of one foot spread . . . two small punctures which bled profusely . . . a few minutes later Simpson experienced a tingling sensation, and that night the hand swelled to obliterate the outline of his knuckles. Four weeks elapsed before the swelling disappeared.'

(From *Natural History*, May, 1951)

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR ENDING 31st DECEMBER 1950.

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Mr. W. S. Millard, F.Z.S.

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Dr. Baini Prashad, D.SC.	*New Delhi*

HONORARY SECRETARIES' REPORT FOR THE YEAR 1950

THE SOCIETY'S JOURNAL

During the year parts 1, 2 and 3 of Vol. 49 were published together with Indexes to the end of volume 47.

The idea of publishing quarterly issues has not been abandoned. It is still engaging the attention of the editors, and will be given effect to as soon as feasible.

MAMMALS

Lt.-Col. E. G. Phythian-Adams contributed three more parts of his interesting serial 'Jungle Memories' which are well illustrated as usual.

Lt.-Col. R. W. Burton's painstaking 'Bibliography of Big Game Hunting and Shooting in India and the East' is most welcome since many of the publications he has listed are already out of print and long forgotten.

In 'A Novel Method of destroying Man-eaters and Cattle-lifters without Fire-arms' S. R. Daver describes a clever method practised by Baigas of Mandla district in C.P. (Madhya Pradesh) for ridding themselves of these dangerous vermin.

Mr. Daver preludes his article with a statement showing the special rewards etc. advertised by the M.P. Government for destroying particular cattle-lifters and man-eaters, and attempts to show how much more economical and effective it would have been for them not to have withdrawn the regular prescribed rewards formerly in force.

Part II of 'The Gir Forest and its Lions' by M. A. Wynter-Blyth and Kumar Shree Dharmakumarsinhji, describes the methods employed and the results of their census which revealed that there were at present between 243 and 251 lions in all living in the Junagadh Gir as against 287 estimated in 1936.

C. A. Gibson-Hill in his 'Note on the Rorquals (*Balaenoptera* spp.)' analyses the published records of the whales stranded on the coast of India and Ceylon with the object of determining the species that occur in this area. He gives a useful key of the external characters of the five known living species which should enable specific identification of the whales met with in the neighbouring seas.

BIRDS

Of the 12 papers on birds that have been published, mention must be made of the one on 'The Lesser Florican: its courtship display, behaviour and habits' by K. S. Dharmakumarsinhji which contains some careful observations on a hitherto unrecorded aspect of the nuptial display.

The versatile C. A. Gibson-Hill has a paper on the 'Tropic Birds of the Indian Ocean'. He tells of the Short-tailed, Long-tailed and Red-tailed tropic birds, their feeding and breeding habits. The paper is well illustrated.

Another paper on the birds of the ocean 'Wilson's Storm Petrels, Shearwaters and other sea birds in the Gulf of Aden & Indian Ocean'—is the carefully kept diary of W. W. A. Phillips during a voyage.

Lt.-Col. R. S. P. Bates has an excellently illustrated article on 'The Lower Sind Valley and some further observations of Bird photography' in which he has many useful tips to the bird photographer.

Horace G. Alexander contributes some field notes on the genus *Phylloscopus* in Kashmir.

Three important regional papers were published during the year: (1) 'Notes on the Birds of the Irrigated area of Minbu district, Burma' by W. L. Roseveare, (2) 'Birds of Nepal (1947-1949)' by S. Dillon Ripley and (3) 'More Notes on the Birds of the Nepal Valley' by B. E. Smythies.

On the taxonomic side we have papers 'On the Shrike *Lanius tephronotus* (Vigors) with remarks on the *erythronotus* and *tricolor* groups of *L. schach* and their hybrids' by Biswamoy Biswas. The results are based on a critical study by the author of 375 birds in various museums in the U.S., the British Museum and the Indian Museum, Calcutta.

Daniel Marien has notes on some Asiatic Sturnidae and Meropidae while S. Dillon Ripley has one on *Turdus merula* in South India which attempts to clear up the tangle of the status of various races that have been recorded thence in the published literature.

REPTILES

In 'Turtle-fishing in the sea around Krusadai Island' G. K. Kuriyan describes methods of capturing marine turtles. His note deals with the respective economic importance of several species.

A second paper by M. N. Acharji entitled 'Edible Chelonians and their products' which gives the three different forms of chelonians, i.e. marine, freshwater and land, together with notes on their commercial value.

FISH & FISHERIES

No contribution was received during the year.

INVERTEBRATES

As usual, this section covered a wide field and published articles like: 'The fouling organisms of pearl oyster cages' by George K. Kuriyan, 'The Mysore Lac Insect' by S. Mahdihassan and 'Observations on the bionomics and fishery of the Brown Mussel (*Mytilus* sp.)' by S. Jones.

F. N. Betts has a paper 'On a collection of butterflies from the Balipara Frontier tract and Subansiri area (North Assam)' while A. C. Harman contributes a list of butterflies from Champaran—North Bihar. These papers help to fill some glaring gaps in our knowledge of the distribution of Indian butterflies.

Other papers of note are 'Observations on some larval and post-larval stomatopods' by K. H. Alikunhi and 'Life history and bionomics of the Cat Flea—*Ctenocephalides felis* Bouche' by K. R. Karandikar and D. M. Munshi.

Miss Theresa Clay has an important paper entitled 'A Preliminary survey of the distribution of the Mallophaga (feather-lice) on the class Aves'. A study of the Mallophaga infesting bird feathers has suggested their importance in determining the phylogenetic relationships of various groups of birds which are their hosts, and holds much promise of throwing light on obscure problems in this connection. The study is in its infancy in India.

BOTANY

Rev. Fr. Santapau has two important contributions, 'Notes on the Scrophulariaceae of Bombay' and 'Notes on the Lentibulariaceae of Bombay'.

J. C. Culshaw has produced a useful working list of West Bengal plants entitled 'Some West Bengal Plants'.

N. L. Bor describes two new species of Ischaemum—*I. bombaiense* Bor and *I. santapaui* Bor.

A New variety of *Cucurbita maxima* is recorded by C. Rajasekhara Mudaliar.

MISCELLANEOUS

This section of the *Journal* which includes items of general interest to naturalists and sportsmen has been well maintained, and we hope that members will continue to contribute notes and observations and experiences to it whenever they have an opportunity.

PUBLICATIONS

'The Study of Indian Molluscs' by the late James Hornell is in the press and we hope to have it out during the course of the year. The republication of the serial 'Some Beautiful Indian Climbers and Shrubs' by Bor and Raizada in book form is also in hand, and attempts are being made to expedite publication. The Ministry of Natural Resources and Scientific Research, Government of India has kindly agreed to bear half the cost of the publication of M. A. Wynter-Blyth's 'Butterflies of the Indian Region' and it is hoped to get this also moving within a reasonable period.

EXPEDITIONS

On behalf of the Prince of Wales Museum, the Assistant Curator, Mr. V. K. Chari, assisted by Mr. Gilbert Nogueira the senior assistant, and the artist Mr. Ram P. Subedar, visited Krusadai Island for a period of two weeks. Material for a dozen habitat groups for the invertebrate gallery has been collected, and work on it at the museum is progressing. Mr. Sálim Ali visited Berar on a bird survey for about three weeks in January and 300 specimens were collected. The results will be published in due course.

FILM SHOWS AND TALKS

On 10th May 1950, films lent by the British Information Services were shown to members and their friends.

On 19th December Mr. Sálim Ali, the Society's delegate to the 10th International Ornithological Congress held at Uppsala in June delivered a talk accompanied by cine-films of his birding excursions in various parts of Sweden and his visits to places of ornithological interest on the Continent.

NATURE EDUCATION

The Nature Education Scheme sponsored by the Government of Bombay has been continued, and talks on 'Animal Respiration' and 'Dispersal of fruits and seeds' and 'Insect Life' were given in Marathi, Gujarathi and English to over 1,500 children.

Teachers of Secondary and Primary Schools were acquainted with the facilities available at the Natural History Section of the Prince of Wales Museum for effectively teaching nature study to children and with methods for creating a genuine interest among them.

Four more plant study sheets were brought out for distribution among schools. Field trips to study plants and animals were also arranged in which a large number of teachers participated.

WILD LIFE PRESERVATION

The Society has reason to be gratified with the passing of the Bombay National Parks Act 1950 which provides for the appointment of a nominee of the Society on the Advisory Committee. It is hoped that the Society will be able to collaborate usefully with Government both in the State and at the Centre.

REVENUE ACCOUNT

The total receipts during the year amounted to Rs. 46,231-3-6 as compared with Rs. 48,794-12-4 during the year 1949. The decrease of Rs. 2,563-8-10 is mainly due to fall in the revenue from calendars, back journals and other publications. Out of the Bombay Government grant of Rs. 4,000/- for 1949-50, Rs. 2,000/- was received in 1949 and was included in the Society's 1949 accounts. The balance of Rs. 2,000/- received during this year is shown in the present accounts.

The total number of members on our books on 31st December 1950 was 1,438, i.e., an increase of 5 members only over 1949. But the number of members actually paying subscription in 1950 was 672 compared with 767 in 1949.

The sales of the Society's publications have dropped further, and the total sales are considerably lower than those in previous years. This is partly due to the Society not having brought out any new publication during the year and partly to the two popular books, viz. 'Book of Indian Birds' (Fourth Edition) and 'Book of Indian Animals' (First Edition) having been on sale for nearly four years with the result that the demand for them is almost satiated.

COMPARATIVE STATEMENT SHOWING THE DIFFERENT SOURCES OF REVENUE RECEIVED IN 1949 AND 1950.

	Revenue in 1949	Revenue in 1950	Increase in 1950	Decrease in 1950
	Rs. a. p.	Rs. a. p.	Rs. a. p.	Rs. a. p.
Subscription ...	21,442 11 7	21,841 0 11	398 5 4	——
Entrance Fee ...	1,920 0 0	1,725 0 0	——	195 0 0
Publications ...	6,482 8 3	4,157 14 4*		
		3,325 2 7†	1,000 8 8	——
Interest on Investments	3,278 10 0	3,298 9 0	19 15 0	——
Sundries, Taxidermy, Advertisement etc. ...	1,670 14 6	1,883 8 8	212 10 2	——
Grants: Govt. of India.	8,000 0 0	8,000 0 0	——	——
,, Govt. of Bombay ...	6,000 0 0	2,000 0 0	——	4,000 0 0
Total ...	48,794 12 4	46,231 3 6	1,631 7 2	4,195 0 0

Net decrease in revenue in 1950 over 1949 Rs. 2,563-8-10.
*Books etc. †Journals.

Staff

The post of the Curator has been vacant since 1-2-1950 for want of a suitably qualified and experienced man on the scale of pay prescribed.

The work of the entire staff has been satisfactory during the year and the Committee wish to record their appreciation of the same.

Acknowledgment

The Society's grateful thanks are due to Mr. W. S. Millard who continues to guard its interests zealously in London.

APPENDIX TO THE HONORARY SECRETARIES' REPORT COVERING THE PERIOD JANUARY TO SEPTEMBER 1951

(Read by Humayun Abdulali, Jt. Hon. Secy.)

"The Report, a copy of which has been handed over to you, covers the year ended 31st December 1950 and I will present a short account of our subsequent activities.

The April issue of the *Journal* must have reached you and we hope to be able to send you the August number before the end of this month.

I am afraid that none of the other publications referred to in the report have as yet been completed though slow progress is being made.

Subsequent to the Bombay National Parks Act 1950, the Bombay Legislature has passed the Bombay Wild Animals and Wild Birds Protection Act, 1951 with the drafting of which the Society was actively associated. This also provides for the Society's representation on the Advisory Boards, and a Sub-Committee is now drafting regulations and bye-laws for the working of the Act which it is hoped will be functioning as from November. Though the lead has been set by Bombay, the Central Government also is now alive to the fact that wild life protection and national parks are matters which need immediate action. In July an All-India Conference was called in Delhi to discuss ways and means, and the Society was also invited to send a representative. Though a report has not yet been published, it was unanimously decided that the attention of the other States should be drawn to these problems and it is hoped that pressure from the Centre will induce others to follow Bombay's lead. It is obvious that in practice legislation in this direction is but the first step, and the law will require public support to make it effective. It is hoped that members of the Society will do all they can to make this legislation successful.

You are aware that a few years ago we offered an annual scholarship of Rs. 600 to one or more students and others working on specific outdoor problems of natural history. In the first year the scholarship was divided between two undergraduates, one working on bats and was divided on algae of hot-water springs. Unfortunately neither of these gentlemen completed their work and the scheme was more or less dropped on our part. The Committee has, however, decided to renew the offer and we hope that many applicants will come forward and that it will be possible to make and retain contacts with young people interested in this fascinating subject. While the amount which we offer is not large, it is hoped that it will encourage those seriously interested to pursue their hobbies which at a later stage might lead to more valuable and interesting work being done by them.

The main report indicates that the total number of members who paid their subscriptions in 1950 was 672. The number for this year is 660 which together with 217 life members means a valid membership of 877 members.

For the Society to undertake further activities other than the publication of the *Journal* it is essential that it should have greater co-operation from members and it is hoped that all of you will try and get all such friends of yours who have any interest in natural history to join the Society."

The election of the following 65 members since the last general meeting was announced.

From 5th October 1950 *to 31st December* 1950

Maj.-Gen. H. Williams, New Delhi; Mr. J. P. L. Gwynn, I.C.S., Ellore, West Godavari District; Mr. D. K. Macfarlane, Nazira P.O., Assam; Mr. A. E. Povey, Worli, Bombay; Mr. B. F. H. B. Tyabji, I.C.S., New Delhi; Sir Roger Thomas, C.I.E., 66, Clifton Quarters, Karachi; The Delhi Gymkhana Club Ltd., New Delhi; Rai Bahadur Kuar Ambika Prasad Sinha, P.O. Chainipur, Dist. Palamah (Bihar); Mr. N. A. B. Warner, Balijan North T.E., Chabua, Upper Assam; The Deputy Conservator of Forests in Baluchistan, Quetta, Pakistan; Mr. Zafar Futehally, Hornby Road, Bombay; Mr. Leslie Turner, North Lakhimpur P.O., Assam; Sir C. V. Raman, Hebbal P.O., Bangalore; The Pisciculturist, Department of Game and Fisheries, Jammu and Kashmir Government, Kashmir;

From 1st January 1951 *to 12th September* 1951

Col. William E. Marling, California, U.S.A.; Mr. E. A. I. Rowland, Bharno Bari T.E., Dooars, West Bengal; Mr. C. P. B. Reid, Victoria House, Calcutta 1; Capt. Stanislav Szafranski, M.SC., A.M.I.E.E., A.M.I., (Mech.) E., Lalbaug, Bombay; Mr. H. C. Grieve, 381, Hornby Road, Bombay; Mr. C. S. Rao, Bhadrachalam, East Godavari Dist.; Mr. D. D. McIntyre, Teloijan T.E., Assam; Mr. J. H. Murphy, c/o British Drug Houses (India), Bombay; Mr. H. P. von Friedlein, c/o Messrs. Hind Cycles Ltd., Worli, Bombay; Mr. L. A. Craven, Chartered Bank Buildings, Calcutta; The Officer-in-Charge, Fisheries Research Station, 6, A.P. Sen Road, Lucknow; The Horticulturist, Government Fruit Research Station, Saharanpur, U.P.; Mr. P. L. Kottyam, 76, Old Custom House Road, Bombay; The Director General of Fisheries, Department of Fisheries, Bangkok, Thailand; Maj. R. J. C. Kenny, Ootacamund, Nilgiris; Mr. R. D. Campbell, Forbes Building, Bombay; Mr. M. Krishnan, Mylapore, Madras; Mr. C. S. Kooi, Middlestum, The Neherlands; The Librarian, Bihar Secretariat Library, Patna; Lt.-Col. W. Tippetts, Kuttiadi Estate & P.O., N. Malabar; The Conservator of Forests, North Western Circle, Alkapur, Baroda; Mr. M. L. Banerji, Meerut College, Meerut; The Principal, Nizam College, Hyderabad—Dn.; The Deputy Director of Fisheries, Uttar Pradesh, Lucknow, U.P.; Mr. M. Burke, Dadar, Bombay; Thakur Mahendranath Shah Deo of Jharia State, Jaria Garh P.O., District Ranchi, Bihar; Lt.-Col. C. F. Hamilton, 1st Mahratta Light Infantry, Ghorpadi, Poona; Lt.-Col. W. A. S. P. J. Lawrence, 51, The Mall, Meerut Cantt.; Mr. F. W. Winterbotham, c/o The Ootacamund Club, Ootacamund; Mr. Peter R. Ryhiner, Twann (Bern), Switzerland; The Librarian, University Library, University of Saugar, Sagar; Durga Pado Malik, Kalna P.O. & T.O., Ambica Kalna Rly. Stn., Burdwan District; Dr. B. G. Afzurpurkar, M.B.B.S., B.HY., Matunga, Bombay; Raja Dinesh Pratap Singh of Kasmanda, Kamlapur P.O., District Sitapur, U.P.; Dr. G. V. Dravid, M.B.B.S., Hindu Colony, Dadar, Bombay 14; Dr. C. Brooke Worth, M.D., Bangalore, S.I.; Rajkumar Jaysinh of Vijaynagar, Vijaynagar, A.P. Rly., Sabarkantha District; Mr. P. Krishnapillai, Palali Government Training College, Vasavilan, Ceylon; The Director, Medical Research Institute, Ceylon, Colombo; Mr. Russell B. Payne, Taunggyi, S.S.S. Burma; Mr. Patrick G. S. Hall, Kumbazha Estate, Travancore; The Quarantine Entomologist, c/o The Directorate of Plant Protection, Quarantine and Storage, Sewri, Bombay; The Reference Librarian, Howard-Tilton Memorial Library, Tulane University, New Orleans, Louisiana; The Superintendent, Ceylon Zoological Gardens, Dehiwela, Ceylon; Mrs. Aruna Banerji, Sunny View, Saharanpur; Mr. H. G. Hundley, Divisional Forest Officer, U.C./Myittha Division, Mawlaik; Mr. D. J. Edwards, Chinnamanur P.O., Madurai District, S.I.; The Principal, Cathedral Boys' High School, Outram Road, Bombay; Mr. H. C. S. Bowdler, Dikom T.E., Upper Assam; Mr. M. Yoshida, Apollo Street, Fort, Bombay.

BOMBAY NATURAL HISTORY SOCIETY

BALANCE SHEET AS AT 31st DECEMBER, 1950

LIABILITIES	Rs A P	Rs A P
Life Membership Fees		88,775 0 0
Advance Subscriptions and Entrance Fees:		347 1 9
Sundry Creditors:		
For Printing, etc., of Journals ...	9,921 14 9	
,, *Expenses:*		
Royalties to Authors of Books ...	227 3 0	
Expenses (Audit Fee, Sales Tax and Telephone Charges) ...	493 9 0	
,, *Others:*	755 6 3	11,398 1 0
Provision for part cost of 'Book of Indian Butterflies'		9,000 0 0
Surplus Account:		
Balance as per last Balance Sheet ...	48,040 0 8	
Add: Excess of Income over Expenditure ...	184 0 6	48,224 1 2
Carried forward...		1,57,744 3 11

ASSETS	Rs A P	Rs A P
Investments: At cost		
Rs. 14,000 4% Bombay Port Trust Bonds.	10,780 0 0	
,, 15,000 4% Bombay Improvement Bonds ...	11,400 0 0	
,, 36,000 3% ,, Funding Loan 1966-68 ...	35,812 10 0	
,, 25,000 3% Conversion Loan 1946 ...	25,000 0 0	
,, 2,000 3% First Development Loan 1970-75 ...	1,948 12 0	
	84,941 6 0	
(Market value on 31st Dec. 1950 was Rs. 91,711-14-0).		
£460 3% Defence Bonds	6,133 5 4	
		91,074 11 4
Furniture:		
As per last Balance Sheet	2,241 10 3	
Less—Depreciation...	135 0 0	2,106 10 3
Sundry Debtors		6,240 13 1
Loans to Staff		160 0 0
Nature Education Scheme: (as per statement attached)		2,431 8 6
Mammal Survey Account		3,333 5 4
Advances for Publications:		
Some Beautiful Indian Climbers and Shrubs:		
As per last Balance Sheet ... 4,570 3 4		
Additions during the year ... 138 9 0	4,708 12 4	
Book of Indian Butterflies:		
As per last Balance Sheet	697 7 6	5,406 3 10
Carried forward ...		1,10,753 4 4

BALANCE SHEET AS AT 31st DECEMBER, 1950—(*Continued.*)

LIABILITIES	Rs A P	Rs A P	ASSETS	Rs A P	Rs A P
Brought forward ...		1,57,744 3 11	Brought forward ...		1,10,753 4 4
			Stock of Books, etc., on hand:		
			(At cost, less depreciation), as certified by the Hon. Secretary:		
			Book of Indian Birds—1,144 copies ...	5,489 0 0	
			Book of Indian Animals—1,554 copies ...	6,216 0 0	
			Circumventing the Mahseer and other Sporting Fish in India—541 copies ...	1,542 0 0	
			Old Journals—12,600 copies	3,150 0 0	
			Bird Picture Post Cards—506 Sets ...	355 0 0	
			Society's Small Publications 666 Charts...	260 0 0	
			Game Birds of India Vol. III Bound and Unbound—452 Nos.	2,081 0 0	
			Calendars—288 Nos.	50 0 0	19,143 0 0
			Cash and other Balances:		
			On hand	294 10 9	
			With the National Bank of India, Ltd., Bombay	20,252 11 11	
			With the National Bank of India Ltd., London, (£547-10-10)	7,30 [illegible] 11	27,847 15 7
Total ...		1,57,744 3 11	Total ...		1,57,744 3 11

We have prepared the above Balance Sheet from the Books of Account maintained and from the information given to us, and have verified the Investments, and Bank Balances. In our opinion such Balance Sheet represents a true and correct view of the state of the Society's affairs according to the best of our information and explanations given to us.

BOMBAY, *30th April, 1951.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants and Auditors.

BOMBAY NATURAL HISTORY SOCIETY

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1950

Dr. *Cr.*

EXPENDITURE	Rs	A	P	Rs	A	P	INCOME	Rs	A	P	Rs	A	P
To Salaries (including Dearness Allowance)				18,108	8	0	By Subscriptions				21,841	0	11
,, Contribution to Staff Provident Fund ...				922	9	0	,, Entrance Fees				1,725	0	0
,, Cost of Printing, etc., of Journal ...				12,755	8	4	,, Journal—retail Sales				3,325	2	7
,, Rent				,680	0	0	,, *Publications:*						
,, General Charges				882	11	4	Profits on:						
,, Stationery and Printing				592	15	3	Book of Indian Birds	1,653	5	3			
,, Postage				925	2	0	Circumventing the Mahseer and Other Sporting Fish, etc.	40	4	7			
,, Library	631	10	7				Indian Hill Birds	50	14	6			
Less: Surplus on Donation ... ... (including Rs. 239-0-9, being the membership fee to the International Union for the Protection of Nature)	75	3	6	556	7	1	Whistler's Popular Handbook of Indian Birds	55	9	3			
							Flowering Trees of India, etc. ...	352	12	0			
							Bird Picture Postcards	27	14	6			
							Society Publications (Snake Charts) ...	805	7	3			
,, Fire Insurance				150	0	0	Calendars	1,314	13	9			
,, Audit Fees				250	0	0	Taxidermy Work, etc.	1 883	8	8			
,, Bad Debts				88	6	0		6,214	9	9			
,, Depreciation on Furniture				135	0	0	*Less*: Loss on						
,, Provision for part cost of Book of Indian Butterflies				9,000	0	0	Game Birds of India Vol. III 146 9 10 Book of Indian Animals 26 8 11	173	2	9			
,, Excess of Income over Expenditure transferred to Balance Sheet ...				184	0	6	,, *Government Grants:*				6,041	7	0
							Government of India	8,000	0	0			
							Government of Bombay	2,000	0	0	10,000	0	0
							,, Interest on Investments (Net)				3,298	9	0
Total ...				46,231	3	6	Total ...				46,231		6
Game Birds of India Vol. III							By Sales during the year				343	3	0
To Stock on 1st January, 1950:							,, Stock on 31st December, 1950						
Bound Copies	390	0	0				Bound copies	281	0	0			
Unbound Copies	2,000	0	0				Unbound copies	1,800	0	0			
				2,390	0	0					2,081	0	0
,, Royalties to Author				131	3	0	,, Loss transferred to Income and Expenditure Account				146	9	10
,, Sundry Charges—Packing, etc.				49	9	10							
Total ...				2 570	12	10	Total ...				2,570	12	10
Book of Indian Birds 4th Edition:													
To Stock on 1st January, 1950				8,410	0	0	By Sales during the year				6,026	2	3
,, Royalties to Author				1,114	0	0	,, Stock on 31st December, 1950				5,489	0	0
,, Sundry Charges—Packing, etc.				337	13	0							
,, Profits transferred to Income and Expenditure Account				1,653	5	3							
Total ...				11,515	2	3	Total ...				11,515	2	3

Dr. INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st DECEMBER, 1950—(continued.) Cr.

EXPENDITURE	Rs A P	Rs A P	INCOME	Rs A P	Rs A P
***Book of Indian Animals*, 1st Edition**					
To Stock on 1st January, 1950		9,044 0 0	By Sales during the year		3,224 10 7
,, Royalties to Author		205 0 0	,, Stock on 31st December, 1950		6,216 0 0
,, Sundry Charges—Packing, etc.		218 3 6	,, Loss transferred to Income and Expenditure Account		26 8 11
Total ...		9,467 3 6	Total ...		9,467 3 6
Circumventing the Mahseer and Other Sporting Fish in India, etc.					
To Stock on 1st January, 1950		2,161 0 0	By Sales during the year		814 2 1
,, Royalties to Author		96 0 0	,, Stock on 31st December, 1950		1,542 0 0
,, Sundry Charges—Packing, etc.		58 13 6			
,, Profit transferred to Income and Expenditure Account		40 4 7			
Total ...		2,356 2 1	Total ...		2,356 2 1
***Wild Life Calendar* 1951**					
To Cost of Printing, etc.		3,016 8 0	By Sales during the year		4,916 0 6
,, Sundry Expenses		604 10 9	,, Stock on 31st December, 1950		50 0 0
,, Profit transferred to Income and Expenditure Account		1,344 13 9			
Total ...		4,966 0 6	Total ...		4,966 0 6
Bird Picture Postcards					
To Stock on 1st January, 1950		547 0 0	By Sales during the year		233 8 9
,, Sundry Charges—Packing, etc.		13 10 3	,, Stock on 31st December, 1950		355 0 0
,, Profit transferred to Income and Expenditure Account		27 14 6			
Total ...		588 8 9	Total ...		588 8 9

BOMBAY, *30th April, 1951.*

(Sd.) A. F. FERGUSON & Co.,
Chartered Accountants and Auditors.

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

Receipts and Payments Account for the Year ended 31st December, 1950

RECEIPTS	Rs	A	P	PAYMENTS			
To *Grant from Government of Bombay :*				By Balance—due to Society as per last Balance Sheet b/f ...	52	10	3
Second half for the year 1949-50	2,390	0	0	,, Cost of Plant Study Sheets	1,068	5	0
				,, Salary of Nature Education Organiser (1-1-50 to 31-12-50)...	3,780	0	0
,, *Plant Study Sheets*—Sales	315	5	6	,, Postage	76	3	0
,, Balance—Advanced out of Society's Funds	2,431	8	6	,, General Expenses (Stationery, Conveyance, etc.) ...	159	11	9
Total ...	5,136	14	0	Total ...	5,136	14	0

BOMBAY, *30th April, 1951.*

(Sd.) A. F. FERGUSON & CO.,
Chartered Accountants and Auditors.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE BOMBAY NATURAL HISTORY SOCIETY HELD IN THE CONFERENCE HALL OF THE B.E.S. & T. UNDERTAKING, ELECTRIC HOUSE, ORMISTON ROAD, BOMBAY, ON WEDNESDAY THE 12TH SEPTEMBER 1951, AT 6 P.M. WITH REV. FR. H. SANTAPAU, S.J., IN THE CHAIR.

1. The Honorary Secretaries' Report for the year ended 31st December 1950 having been circulated was taken as read. The Jt. Honorary Secretary then read the supplementary report on the activities of the Society during the period January to August this year (*see* p. 442).

2. The balance sheet and statement of accounts presented by the Honorary Treasurer were approved and adopted.

3. The Committee's nominations to the Executive and Advisory Committees, as previously circulated to members, were accepted. There was one addition to the Executive Committee—the nomination of Mr. G. V. Bedekar, I.C.S., who agreed to serve on it.

The formal business of the meeting concluded with an excellent colour cine film show of Kashmir birds by Mr. Sálim Ali made during his recent study-cum-holiday tour of Kashmir. The film was greatly appreciated by all present.

WANTED

One copy each of the following back numbers of the Journal of the Bombay Natural History Society :—

Vol. 29, No. 1 Vol. 44, No. 2
Vol. 31, Nos. 1 and 4 Vol. 45, No. 2

Please quote lowest for all or any of these to E. P. GEE, Doyang Tea Estate, Oating P.O. & T.O., Assam.

PRINTED AND PUBLISHED BY V. M. PHILIP AT THE DIOCESAN PRESS
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EDITORS: SALIM ALI, S. B. SETNA AND H. SANTAPAU
114 APOLLO STREET, FORT, BOMBAY

NOTICE TO CONTRIBUTORS

Contributors of scientific articles are requested to assist the editors by observing the following instructions:

1. Papers which have at the same time been offered for publication to other journals or periodicals, or have already been published elsewhere, should not be submitted.

2. The MS should preferably be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

3. All scientific names, to be printed in italics, should be underlined. Both in zoological and in botanical references only the initial letter of the genus is capitalized. The specific and sub-specific names always begin with a small letter even if they refer to a person or a place, e.g. *Anthus hodgsoni hodgsoni* or *Streptopelia chinensis suratensis* or *Dimeria blatteri*.

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected. In all other cases, or where identification is based merely on sight, binomials should be used.

5. Photographs for reproduction must be clear and show good contrast. Prints must be of a size not smaller than 3¼ × 2¼ inches (No. 2 Brownie) and on glossy glazed paper.

6. Text figures, line drawings and maps should be in Indian ink, preferably on Bristol board.

7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name with the abridged titles of journals or periodicals underlined (italics), and titles of books *not* underlined (roman type), thus:

Roepke, W. (1949); The Genus Nyctemera Hübner. *Trans. ent. Soc. Lond.*, **100** (2); 47-70.

Prater, S. H. (1948); The Book of Indian Animals, Bombay.

Titles of papers should not be underlined.

8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus: (Roepke, 1949).

9. *Synopsis*: As recommended by the Royal Society Scientific Information Conference (July 1948), the editors consider it desirable that each scientific paper be accompanied by a synopsis appearing at the beginning, immediately after the title. The synopsis should be factual. It should convey briefly the content of the paper; draw attention to all new information and to the author's main conclusions. It should also indicate newly observed facts, the method and conclusions of an experiment, and if possible the essential points of any new finding, theory or technique. It should be concise and normally not exceed 200 words.

When the synopsis is complete it should be carefully revised by the author to clarify obscurities, and further compressed wherever possible without detracting from its usefulness.

114 Apollo Street, Fort,
Bombay 1.

EDITORS,
Journal of the Bombay Natural
History Society.

THE SOCIETY'S PUBLICATIONS.

Mammals.

Book of Indian Animals, by S. H. Prater, with many coloured and black and white plates. **Rs. 16.**
(*Price to Members Rs.* 13).

Birds.

Game Birds of India, Vol. III. Pheasants, 1st Edition. **Rs. 32.**
(*Price to Members Rs.* 24).

Book of Indian Birds, by Sálim Ali, with many colour and black and white plates, 4th edition, revised and enlarged. **Rs. 16.**
(*Price to Members Rs.* 12-8).

Set of 12 Coloured Picture Postcards of Common Indian Birds. Rs. 2-4 net.

Fish.

Circumventing the Mahseer and Other Sporting Fish in India and Burma. Rs. 15.
(*Price to Members Rs.* 12).

Snakes.

Identification of Poisonous Snakes—
Folding Chart. **Rs. 2-8.**

Miscellaneous.

Wall Chart to distinguish a Wild Dog from a Domestic Dog or Jackal, etc. Rs. 2-8.

Back Numbers of the Journal.

Back numbers of the Society's Journal. Rates on application.

Obtainable from :

The Honorary Secretary,
Bombay Natural History Society,
114 Apollo Street, Bombay 1.

London Agents :

Messrs. Wheldon & Wesley Ltd.,
83/84 Berwick Street,
London, W. 1.

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1952 Vol. 50 No. 3

JUNGLE MEMORIES

BY

Lt.-Col. E. G. Phythian-Adams, o.b.e., f.z.s., i.a. (Retd.)

Part XI—Odds and Ends

(*With two plates*)

(*Concluded from p. 223 of this volume*)

Two Days in the Mudumalai Forest

Mudumalai, in the Nilgiris-Wynaad, has for the last 27 years been my favourite centre for big game shikar, and from my diaries I could extract sufficient material for a small book. But with conditions so greatly changed now in many parts of India from what they were in the past, I think that my readers will prefer an account of what things are like today (1951), even though the outings are for a few hours only and not serious shikar.

It is the 21st April and my first jungle trip this year. A Brain-fever bird is calling, but it is early in the season and he can manage only the first half of his monotonous notes. As we came through the forest yesterday from Kargude, I noticed that fire had swept right through the Wild Life Sanctuary. The question is whether it was held up by the big Mudumalai swamp which forms a natural fire-line, or whether it has continued on to Narati and Benne. On this will depend our chance of seeing game. It is therefore with some relief that after passing the causeway I find that the whole area has been burnt, and that visibility is from 100 to 200 yards. There has been no rain for some days, but the debris in the roadside drains shows that heavy storms have occurred recently. Everything looks fresh and green. The young grass is sprouting, and the trees are putting out their new foliage in many shades of green and russet brown, the monotony being broken here and there by a gorgeous yellow laburnum, or what looks like it, in full bloom. Though it is the hot weather there is quite a nip in the air, and with the windscreen up I am glad of my muffler. My driver evidently thinks the same, as he has donned a pull-over. As we turn a corner near the second milestone we see a jungle-sheep (kakar) standing by the side of the road 150 yards ahead. The glasses show it to be a female, and though the game rules permit them to be shot, I prefer not to fire. Probably she has a fawn in the lantana thicket close by which, though scorched by fire, still affords good shelter.

We continue on our way, and as we approach the 5th mile I wonder how the elephant encampment has fared. All has gone up in smoke and only a few charred uprights remain to show where the numerous huts stood. The high arched bridge over the stream appears derelict and proves to be so, but a low wooden structure has been built alongside which we cross. Half a mile further on, while I am looking out to the left watching a pair of honey buzzards mewing round the top of a tall tree and no doubt selecting a site to nest, my driver suddenly stops the car and whispers 'Bison'. I look to the right, and there on the open slope above us and not 60 yards away stands a grand bull still munching the young grass which he was plucking when the noise of the car disturbed him. His jet black colour shows him to be a mature animal, but the horn spread is no larger than what I already have, and the points are sharp and unbroken. He shakes his head and advances a few paces towards us. I cannot help thinking that if he does decide to be nasty, the downhill impetus of that mass of bone and muscle will knock the car flying. However, my experience is that 99 times out of 100 bison are mild tempered beasts, and this one proves no exception, for after a good stare he swings round and trots off. We resume our way and are soon passing the big swamp which runs down from Narati hill. Usually there is a herd of chital to be seen here but today it is blank, so we turn to the right a little way up the forest road and park the car. I send George off with Ankan to work the ground across the stream. Veeran is left to mind the car, while I start uphill with Vasu and Masty.

The road, rising by easy gradients, runs along the hill-side, and judging by the number of fallen trees has not been used by traffic since early last year. The first part passes under high arching bamboos whose dew soaked leaves thickly cover the ground. Springing up through them are numbers of a pale mauve and white crocus, and I am admiring a large cluster of these, when a jungle-sheep dashes across the road and down to the swamp on our right. Vasu, whose eyes are exceptionally keen, points out what looks to me like the stump of a half hidden dead tree below us and says it is the buck, but before I can verify it the animal bolts. Continuing our way, soon after I spot a small herd of chital high up on the open hill-side above us. They have seen us too and disappear round the corner of the hill, but the only buck with them has half grown horns in velvet, so we leave them alone. Two shots from the direction of the car now show that George is in action. I hope he has got something, preferably a pig for the men, who are so fond of pork. On again up the winding track, moving very slowly all the time, for 2 miles an hour is the utmost for still-hunting. We see fresh marks where a pig has been rooting, and I carefully stalk a re-entrant where I shot a big one last year, but there is nothing there today. We should by now have seen more game, but probably they have not yet returned after the recent fire. Malabar squirrels, however, make their presence known by their sharp chattering cry every few hundred yards. Lovely ceatures, with their bright cinnamon and orange coats—quite rightly they are on the protected list. There is a certain amount of bird life even in this heavy tree forest. On the edge of the swamp below us a Malabar Whistling Thrush is giving a fine rendering of his 'Idle Schoolboy' theme—an unusually fine performer. The monotonous call of green barbets also breaks the silence, and occasionally the heavy flight of a golden-backed woodpecker, but the chief sound is the continual chatter of many pairs of Southern grackles, obviously nesting.

We pass the fire-line, looking down on the road crossing the swamp far below us, and are now approaching an exceptionally favourable spot where only last year I shot both jungle-sheep and pig, and even saw a small herd of elephants with a fine tusker, but today our luck seems to be out. However, it is time for a halt, so I take up position on the slope covering a glade below and wait hopefully. Above us is a huge tree whose crown must be in full flower judging by the sickly sweet scent and the hum of hundreds of bees overhead. After some time a doe jungle-sheep appears, so I wait a little longer in case she is in company with a buck, but apparently she is alone. I decide to give it up, so we stroll back slowly to the car, again seeing our friend of this morning who is far too wideawake now to give another chance. Shortly after George turns up also empty handed. He had an easy chance at a fine chital buck which he estimated at 36″ (and in my experience his estimates are generally on the conservative side), but the cartridge missed fire. The buck bolted, and his two shots which I heard missed.

We start back, seeing nothing till we reach the causeway near the Hut. Here some 20 grey langurs are sitting out in the swamp, all with their backs to us and quite 100 yards from any tree. They are widely spaced, and I cannot make out what they are doing, but Ankan tells me that they are feeding on a small white berry to which they are very partial, and which ripens at this season. They are too intent on their business to pay any attention to the car. It certainly is extraordinary to see so many on the ground at once and right out in the open. And so ends a very pleasant morning. True, we have got nothing, but personally I am quite satisfied with my outing, though I am afraid my companion is less so.

Two days later I decide to prospect up the Doddakatte path, a favourite route of mine. Last evening I had sent George to clear away any fallen trees etc. so we hope to cover the first three miles by car, though generally the track is only jeepable. Again we leave at dawn, and a few minutes run brings us to the stream which is likely to prove our biggest obstacle. The bridge was burnt many years ago and has not yet been replaced, but George has laid a corduroy of logs and branches across the water, and with some wheel spinning the old 'A' model Ford (an ideal car for shooting) crosses and climbs up through the heavy sand on the opposite bank. The forest road we are following forms the boundary of the Wild Life Sanctuary which lies on our right, and almost at once we see a herd of some 25 chital with several good bucks, but all in velvet. The sun has not yet risen and their coats look unusually dark in the dawn light. After a good look at us they swing round and make off. All this area has been burnt, so visibility is good—usually one is shut in by walls of tall grass for the first two miles. For me the road is full of memories of panther, bison, deer, and wild dogs over the many years I have been using it.

As we top the rise we run out of the big tree forest. Here the jungle is lighter and the grass never more than two feet high. It is a favourite locality for chital, but today we see nothing, and shortly after we reach the Honurhatti cross roads where the car is parked under a tree in which I have often had a machan. George turns off to the right here, along the north boundary of the Sanctuary, making for the salt licks near the Mysore frontier 3 miles away. I continue along the path towards Doddakatte which soon sweeps round in a mile long curve with clear visibility to the end, as the low tree jungle has been cut back some way on each side. We have not proceeded far when I notice the tracks and droppings of a big tiger which had gone overnight in the same direction. It was just here many years ago I found the bleached bones and skull of a man who, according to Masty, had been killed and eaten by a tiger. As evidence he produced a silver ring which he said he had found in the animal's dropping. However, nothing remains today of that tragedy, and shortly after we see some chital feeding about 500 yards ahead, so slip down to the edge of the jungle on our left for a closer approach. This presents little difficulty, and we are soon within 100 yards of the deer. The thick growth of saplings somewhat obstructs our view, but after watching for some time I satisfy myself that no really good buck is present, so we move on.

The road now forks, the branch on the right going downhill to the Doddakatte *maidans*, while that on the left runs uphill round the side of Karadibetta hill. I take the latter and almost at once spot some chital coming down it about 400 yards away. There is a good buck with them—his antlers have a wide spread and incurving tips, and I can see that the latter are white. I estimate him at 35″ and decide to have a closer look, so again we slip into the jungle on our left and work towards them. But the wind is tricky, and as we approach I feel a puff on the back of my neck. The inevitable happens, and with a rush the deer bolt across the road to our right and disappear downhill. A fleeting glance at the buck's head shows that I was not mistaken as to its size, but they are now alarmed and it is not worth while to follow them. We mount steadily and as we top the rise Vasu spots some sambar feeding uphill on our right. The stag is in hard horn but the head is small, so we proceed slowly only to run almost at once into another herd of chital who bolt on getting our wind. These are all bucks, some 20 in number and most of them are in velvet. There must be a master buck somewhere about who has driven them from the herd.

The wind is so fitful that I decide to halt for 15 minutes to give it a chance to steady. We sit with our backs to the hill, with an uninterrupted view over miles of forest to the Nilgiri hills standing stark and clear after last night's rain—a wonderful panorama. Around

Photo *E. P. Gee*

The author in his study.

Down the Benne road.

Photos *Author*

Mukerti Peak.

us are numbers of pre-historic graves, so far undisturbed. Presumably they have some connection with the big fortified hill of Gopalswamibetta not far away on our left which was occupied in the first and second centuries, but has not yet been excavated. I am wondering what manner of people these were and how they managed about their shikar, when my reflections are cut short by the roar of a buck downhill on our right and not far away. Evidently this is the master buck; he should be worth looking at. The wind seems to have steadied so we go after it and almost at once run into a herd of bison. But the wind has swung round again and betrays us, and off they go like a cavalry charge, unfortunately taking with them a big lot of chital who make for the top of the hill. In hopes that this lot did not contain the master buck we work on still downhill. Everywhere are fresh droppings and tracks of bison and chital, in fact the game path across one nullah looks like a regular farmyard road, but the deer have gone.

Time is passing and I have arranged to be back at the car by 10 a.m. so we circle back to the road above us. We have not gone far when I see something black moving through the grass about 80 yards away. Only the top of the back is visible and at first I think it is a pig, but the glasses show it to be a sloth bear, the first I have seen in this forest in so many years, though their tracks are not uncommon. I do not want it, and a minute later am glad I did not fire, as a small cub now appears some yards behind following its mother. We leave them in peace and move up to the road. Just beyond the spot where we halted some more chital are viewed uphill on our left. They have seen us and bolt round the corner of the hill, but the wind is, for a wonder, in our favour, so they are not seriously alarmed. Some large rocks overhanging the valley afford cover and soon I am within easy range, but the best head does not exceed 32″ so I let them go.

I have no regrets for a blank day, as my chief object is to view the forest life, and to discover how far the chital have recovered from the war years, when all this area was handed over to a Jungle Warfare training school. That game has now returned in good numbers is obvious, and when I meet George I find that his impressions coincide with mine. He had come across great numbers of chital as well as bison, but pig, of which I hoped he would bag one for the men, were conspicuous by their absence. Curious this, as we used to see them almost every day.

Two blank days running ! Hardly worth recording, some may think. But this is an account of memories of the jungle, and not mere a record of slaughter, so I hope the majority of my readers will not be disappointed that I brought no record head to bag. With me, at any rate, the pleasure derived from the hunt and the enjoyment of the sights and sounds of the jungle far outweigh other considerations.

SMALL GAME

I suppose I cannot have been more than 15 when I started to use a gun. It was during the summer holidays and my parents were away for the day. So good an opportunity was not to be missed. Aided and abetted by my younger brother, I unearthed my father's gun (he had not used it within my memory), found some cartridges and went out into a nearby field of turnips, where I had the luck to bag a rabbit with my first shot. Of course everything came out when the family returned, but I had broken the ice, and from then on was allowed to use the gun in my own right. It was an old hammer gun by Reilly and served me well for many years. The cartridges were black powder ones, and being of an inquisitive turn of mind, I decided to experiment with cordite. It was easy for me to retain a few .303 blanks from the next Cadet Corps field day, and with the contents I reloaded a 12 bore case. Luckily for me the cap was too small to ignite the charge properly and the explosion only propelled the shot a few yards. That was the large type of cordite known as 20 S.C.—if it had been the ordinary kind the gun would most certainly have burst.

How well I remember my first pheasant, a hedgerow one, which fell hard hit into a huge clump of brambles, and how I dived headfirst into them to secure my prize before it could escape. Three more pheasants were pointed out one evening by our coachman. They were busy eating a turnip in the corner of a field and I managed to get within easy range. I waited till all their heads were in line (not very sporting, I am afraid, but I was only a boy), and then click, click, I had forgotten to load!

That was over 50 years ago, and how many thousand cartridges I have fired since then I could not even guess. Most of my heavy shooting has been done since retirement, and I see from my game register that in the year 1938-39 I and my driver between us got rid of over 4,000. That certainly was an exceptional season, but over 2,000 was quite common. And over all those years what grand sport I have had. Pheasants, partridges, hares and rabbits in England, both when I was a boy and during various periods of leave. What fun it was shooting the rabbits as they bolted when the corn was cut, in ever increasing numbers as the area diminished. Ferreting too, but that could be a slow game when the ferret lay up and had to be dug out. Woodpigeons also, shot from a hide of corn stooks, as they came flighting in. I certainly have no complaints about the sport I have enjoyed in England, but Scotland has given me even better.

Is there a finer sporting bird in the world than the red grouse? Whether he is rising from the heather in front, or coming as fast as he can fly over the butts, there is none in my experience to equal him. Most of my grouse shooting has been walking over dogs, and I prefer it that way on account of the varied bag—the odd snipe or golden plover, a hare or a rabbit, and once I remember a roebuck unexpectedly put up out of long heather. The shooting too is more or less continuous and all guns get their fair share. Driven grouse are fine sport, but the shooting is compressed into comparatively short periods of time, and tends to become rather mechanical. Nor do the guns always get an equal chance, for in practically every drive there are some butts over which no birds pass. In Scotland I had blackgame also, including of course the inevitable greyhen shot by mistake for a grouse before the season opened, some woodcock, and even a couple of capercaillie, which were not half such bad eating as some people suppose. I remember drives too on the tops to thin out the blue hares—rather a bloody business, but necessary. There was not much sport about it.

But it is India which has given me most of my sport and so many varieties of game at the numerous stations where I have served. Chikor at Dalhousie—there were pheasants too but I never got one. Black partridges in the *rukh* at Mian Mir, and at an excellent ground some 20 miles downstream from Lahore, which I remember we reached by *fitton-ghari.* Houbara at Karachi, grey partridges (some of which I saw perch in high milkweed fences), blue-rocks flighting in to Kianmari over the parade ground, and sandgrouse coming to water at dawn, when the fun was fast and furious and one's gun got almost too hot to hold. Really first class duck shooting too, and on my second visit see-see in Las Bela. Kamptee, where I joined my Indian regiment in 1905, was a poor station for small game, but our seven weeks march through the Berars made up for it, giving a fresh variety in the shape of painted sandgrouse—I found a low scrub covered hill simply alive with them one evening. Then four years at Poona afforded good mixed shooting—snipe round the Khadakwasla lake, duck, teal and sandgrouse down the line, and really fine bags of quail not far out. I was the lucky possessor of a 3½ h.p. Triumph motorcycle, one of the first seen there, which enabled me to reach grounds further afield than other sportsmen, and what was more important, in less time. My next station was Rangoon, a poor place from both the military and the shikar point of view, though I did get some quite good snipe shooting in the vicinity. After that came the leisurely voyage up the river to Bhamo, when our steamers tied up every afternoon, and we were able to get ashore for a couple of hours' shooting before dark. I remember one evening some birds with long necks passing overhead which I thought were teal. I shot one and found it was a grey imperial pigeon, the only one I have bagged.

At Bhamo we had good snipe shooting just below the fort. I remember that the Fantails used to arrive first towards the end of August. There were a few woodcock, and not far downstream geese, duck, and teal. I was commanding our Mounted Infantry detachment so was able to take out a number of mounted orderlies as beaters, which saved a lot of time. Lesser orange-breasted green pigeons were numerous at certain seasons, and it was while shooting them as they came to a fruit tree standing out of the floods that McR. and I had a narrow squeak. My steel shikar boat was carried by the current under the trailing branches of a tree, and as we bent down to avoid them it filled with water and sank under us. We seized hold of branches and luckily I kept my foot under the thwart, but things looked pretty grim as we were separated from the shore by a mile or so of flooded jungle. Fortunately we found there was a little dry ground at the foot of the tree, so were able to empty the boat and float downstream in pursuit of the paddles etc., all of which we recovered, including the cheroot case which I still use! In fact the only thing we lost was McR.'s signet ring which was rather loose on his finger. Our guns were in the bottom of the boat and were none the worse after a thorough cleaning, but of course the cartridges were all ruined. It was a lucky escape.

There was excellent shooting to be had on the Shweli river along the Chinese border, but my best recollections are of the junglefowl shoots near the rifle range with the recruits as beaters. Rides cut through the jungle made the birds rise, affording very pretty sport. After Bhamo came a short tour of duty in Ceylon, but I was far too busy there to find time for shooting. Then St Thomas' Mount, where I shot my first florican and had grand sport with snipe driven out of betel gardens and from the bush covered slopes of Vandalur hill. Active service in Mesopotamia gave me occasional chances of sport. I remember black partridges at Tanooma and later round my post at Khan Nuktah beyond Baghdad. Also a flock of pintailed sandgrouse in a lucerne field near Basra, which I circled before firing, and then, having got them nicely packed bagged 14 to two barrels. A horrid deed, but they were badly needed for the Mess! At Hyderabad (Deccan) I had quite good quail shooting, as well as duck and teal, and a new variety in the shape of painted partridge. Then Burma again with red junglefowl, silver pheasants, Chinese francolin and Burmese peafowl, mostly up the ghat from Meiktila to Kalaw and beyond.

In 1924 I retired and settled in the Nilgiris, where still more varieties were added to my list: grey junglefowl, spurfowl (both common and painted), peafowl and Nilgiri pigeons. And in Mysore the great Indian bustard, green imperial pigeons, bar-headed geese and demoiselle cranes. Shooting in the Nilgiris certainly has an attraction of its own, not so much on account of the bags, which are generally small, but because of the delightful surroundings and the wonderful freshness of the air, especially when there is a sharp frost. There is something about it that not even the Himalayas can equal. I am of course referring to the plateau. In the low country one gets even better shooting and a greater variety of game, sometimes too much so when there is an unexpected tiger or panther in a beat, but I think that most sportsmen will agree that the former is to be preferred.

Snipe have always been to me the most attractive of all game birds —they have a fascination of their own. Over so many years it is difficult to remember individual incidents, but a few stand out. My first was shot near Gurdaspur in October 1904, on our march down from Dalhousie to Mian Mir. Some of us had gone to try a tank for duck, and I as the youngest and least experienced was dropped first. Unfortunately I was not warned as to who would fire the first shot. After giving the others what seemed ample time to reach their positions, I moved forward to the edge of the reeds fringing the water. and on the way put up a snipe. Up went my gun and I had bagged my first snipe, but of course my shot had put every duck on the wing, and I heard all about it afterwards. Another incident took place at Bhamo in 1914. Three of us were working the ground below the fort, and three snipe rose out of range. After going some way they circled back and came over us from the left in line ahead and so high that it seemed doubtful whether they were within shot. However, the first of us decided to have a try and the others followed suit. Each gun had time to fire one barrel only, and each scored. The first bird had scarcely reached the ground when the last started to fall. Three snipe to three guns with three shots. So completely satisfactory!

A very minor incident no doubt, but remembered when others of greater importance are only a vague memory.

I have had pleasant days after snipe elsewhere, but the backwaters round Cannanore have given me my best sport, and for many years after retirement I used to go down for two or three 10-day visits every year. For anyone who could hold straight and was not afraid of really hard work, it was not difficult to bag 25 couple, sometimes with a few golden plover added. On more than one occasion I have done so and been back at the hotel in time for lunch. Usually I restricted myself to 50 birds, but there was one day when the century was passed. Two drawbacks to shooting in Malabar are the number of people working in the fields and even up palm trees, and the hordes of small boys following to pick up fired cases, which at times combine to put one off rather badly. A third is the deep tenacious mud which makes very heavy going. I have never met anything like it elsewhere, and was interested to find that Col. Welsh, writing 150 years ago, found it equally trying. How they recharged their muzzle-loaders in it, I cannot imagine.

But, apart from the sport, the scenery alone makes a day's outing a very real pleasure. The start at dawn in the dug-out propelled by sturdy Moplahs; the row of an hour or more up the silent stream, with flocks of egrets flighting overhead, and in the distance the Coorg hills flushed with the rising sun, until a ground is reached where conditions of tide and cover are favourable. Then, after shooting it, the return to the boat and a further row to another ground, till about noon one lands for a welcome break and tiffin in the shade of the palms. One of the inevitable small boys is sent up a tree for some tender coconuts, and another to fetch a bunch of those delicious Malabar plantains, while the boatmen, having secured the usual advance, go off to an adjacent tea-shop. Then more shooting till about 3 p.m. when it is time to start back. The tide is now with us, so the boatmen can take it more easily. We meet a number of boats sailing upstream with the help of the sea breeze, and others are overtaken heavily laden with tiles, firewood or coconuts, their cheery crews always ready to crack a joke or ask how we have done. And so back to the hotel, where the bag is checked and distributed, while we slake a thirst which seems unquenchable. Wonderful days! The memory of them will never fade.

Of woodcock my best memory is of a true right and left, i.e. both birds rising together, in a wood on my aunt's estate, 'Trinafour' in Perthshire. Those Scotch birds are very different from 'cock in the Nilgiris, where they are beaten out of *sholas*, and generally give very easy shots in the open. Not but what I have found them quite easy to miss on occasions!

Of geese I remember best a gaggle of about 60 (bar-headed) on a small tank near Gundlupet in December 1930. We had only just reached the place when a couple of scouts came over, which I let pass. Ten minutes later the gaggle arrived, performing the usual amazing aerial acrobatics as they descended to the water. When all had settled, I sent a man round to move them within shot, and then 4 barrels from the bund accounted for eight. Another wounded bird got away to an adjacent tank, but left the water before I came within shot and got into some dense lantana, from which we were unable to recover it. We also had six off the Gundlupet tank in March 1946, but as a rule one was lucky to bag even a single bird throughout the season.

With duck and teal I have had excellent sport in many places, but my chief recollections are of the tanks in Mysore. Soon after I retired in 1924, I started reconnoitring round Gundlupet, and the two years I lived in Mysore enabled me to visit nearly every tank in the district and a number beyond, and so I learnt how to work them according to the height of the water. Then I started organising regular fortnightly parties, and grand sport we used to have. From 1924 onwards my game register is complete, and very interesting reading it makes. The years 1938-40 gave us our biggest bags, five shoots contributing 1414 head, with 187 on the best day, while those in the spring of 1940 totalled 1481. Soon after that I was recalled to service, and my opportunities for shooting were few and far between. I did, however, manage to organise one shoot on 5th April 1942 for the benefit of the Divisional Commander. Four of us from Bangalore and two from the Nilgiris were to meet at Seringapatam at 7 a.m., but at the last minute the General phoned that neither he nor the other two officers could come, so there were only three of us at the rendezvous, instead of six. I had planned to shoot the tanks along the Bannur road, the first of which requires at least five guns, so was doubtful how we should manage. However, with the help of our two drivers to keep the birds on the move, we picked up 91 there, and the bag steadily mounted till finally it reached 202, our best day till then. What the General said when he heard what he had missed, is better left to the imagination! I see that we shot the same tanks again in March 1946 and got 197 head only to eight guns—we ought to have done better—but the 27th March 1948 on the same round gave 206 to six guns, our best day ever. My game register records that at the final check one bird was found to be short, as it had been eaten by one of our dogs! Incidentally the next day also was a good one, for though the total was only 114, it included no less than 69 duck, an unusually large proportion. 320 in two days—good enough!

Are duck and teal decreasing in numbers? With 27 years experience of the Mysore tanks, I can say most positively that there is not the least sign of it. May the day be far distant when sportsmen in South India are limited in their bags of migratory birds to 2 geese and 4 ducks a day, as is the present rule in the U.S.A.!

At individual tanks my best personal bag was 52 duck and teal (mostly garganey) actually picked up for exactly 100 cartridges, which makes it easy to remember. That was at Hadinadu near Nanjangud. I ran out of No. 7 shot cartridges which I always preferred, and had to use No. 9 which I generally kept for snipe. I found that the smaller shot was perfectly effective on birds coming in or crossing. That was a good day, as I was shooting above my average. I remember a somewhat similar one with green pigeons near Gundlupet. It did not seem to matter what the angle was, they were killed dead. It is because such days are with me few and far between that I remember them. I have had some very bad days too, which I have not forgotten, but over those I shall draw a veil!

What constitutes a good shot? Judging by correspondence in the press, opinions seem to vary between 30% and 75% kills to cartridges. The former appears to me absurdly low. I am only a very moderate shot, and yet, as the records in my game register show, I have averaged over 50% during 22 seasons.[1] On the other hand, 75% would surely indicate a star performer, assuming that there was no picking of shots, and that shooting was not confined to a limited variety of game. I should say that anyone who can kill two birds with three cartridges throughout the season is definitely a good shot. I can do that at snipe under normal conditions only when I am shooting really well, and find that with duck and teal one is lucky to pick up on an average one bird to three cartridges, as so many are lost. Of course a single day's shoot is no criterion as so many factors are involved—good or bad light, easy or hard going, and perhaps most important of all the condition of master's liver, on which so largely depends the co-ordination of eye, brain, and hand. For instance, in long dry stubble at Cannanore where the snipe were lying like logs, I once had 17 aces, i.e. consecutive kills to as many cartridges. On another dull and drizzly day when the birds were as wild as hawks I have started off with 10 consecutive misses. So the only fair way is to take the season's average.

As regards size of shot, I am a firm believer in the saying 'it is the pattern that kills', and so have a preference for Nos. 7 and 9. Neither of these being available nowadays, I use principally No. 8 and find that with it I can kill even a driven peacock or a goose stone dead, provided of course it is hit in the head and neck, and it is not much use hitting such large birds anywhere else. To pull down a really high duck, nothing can beat an Alphamax with No. 2, and BB is none too big usually for geese and cranes; but taking it by and large No. 8 shot in the right barrel and No. 6 in the left is, in my experience, the best combination for general purposes.

Before closing this section, a few words on organising a duck shoot may be helpful. It is by no means a simple task. Your party (which should not as a rule exceed five guns) will generally include one really good shot, several average ones, and at least one who is not so good, and you have to arrange matters so that while all get their fair share of shooting, the bag does not suffer, a most important consideration. It is not too easy even when all the guns are personal friends, and infinitely more difficult when others are included. However hard you try there will inevitably be some grumbles, but these can be reduced appreciably if you make it clear at the start that all birds shot go into the common bag to be shared out equally at the end of the day. This is only reasonable, for it may happen that one gun gets more than his fair share of the shooting, while an equally good performer gets too little. It also avoids any dispute as to the owner of a particular bird at the pick-up, always a likely source of friction if each gun keeps his own bag. I have always insisted on an equal share-out, and cannot see how any true sportsman can possibly object to it.

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[1] For those interested in statistics, the following are the actual figures: 1926-36, 9775 head for 19042 cartridges; and 1940-51, 5082 for 9633. For the years 1937-39 I kept no record of cartridges fired by myself alone.

Another important point is that of discipline, by which I mean that once a man has been asked to run a shoot, the other members of the party must subordinate their own wishes to what the leader considers best, either as regards positions or as to the order in which the various tanks are to be taken. The leader should of course invite opinions, but the decision as to what is to be done must rest with him alone, and the others should be prepared to carry out his instructions without demur.

To organise a successful shoot requires most careful attention to detail and really good bandobast, not only as regards the actual shooting but all the preliminary arrangements—the previous reconnaissance to locate the birds, booking of accommodation, co-ordination of transport, boats, food, drinks etc. As I said above, it is far from being an easy task.

FISH

Fishing stories are, perhaps deservedly, treated with some suspicion, so I will not bore my readers with accounts of huge bags and record fish, which indeed I have never achieved.

I have often regretted that I let so many years pass in India before I took up fishing. A brother officer persuaded me to try it at Bhamo during the monsoon of 1913 when there was nothing else to do and time hung heavy on our hands. We had quite good sport with white carp, seetul, and murrel in the tank which formed the fort moat, the best fish, so far as I remember, being a 10-lb. carp taken by one of our Indian officers, but that was exceptional. Having broken the ice, we later tried streams further afield and caught small mahseer and catfish. Nothing much perhaps, but quite good fun. There were porpoises at the confluence of the Taiping river with the Irrawaddy just above Bhamo and I should have liked to try for them, but the Burmese boatmen were averse on superstitious grounds. I have pleasant memories too of *Barilius bola* (Indian trout) on the Kalaw ghat in Upper Burma, and of *Bamin* near Cannanore. On one occasion while spinning for the latter close to the railway bridge at Palayangadi, a 25-lb. ray jumped into the boat and caused some excitement with its threshing tail before it could be despatched. It was only later that I discovered the poison lay in the spike at the base of the tail and not in the tail itself. I learnt also that this particular species is viviparous, for it produced a number of young in the course of the engagement. The rivers of South Kanara and Malabar too gave good fun with small mahseer—nothing over 4 lb., but quite enough for a light trout rod.

My best sport however has been in the Nilgiris. While I was Brigade Major at Wellington in 1916, I found that my General was a keen fly-fisherman, and that was my introduction to the Rainbow trout. Grand sport they have given me since then, and certainly no one would believe it if I totalled my fish diaries. The best period of all was when the Mukerti lake was being formed. That river had always been our best, where fish of a pound were common and generally pink fleshed. As the water rose and the worms were drowned out, the trout got far more than their normal supply of food and put on weight at an amazing rate. I see from my register that in 14 days fishing in 1936 I took 83 fish there weighing 116¼ lb., and in 1938 a total of 88 weighing 128 lb. 5 oz., the best being 3 lb. 1 oz. I mention these figures to show how fine the sport was. Others more expert than myself did even better.

Since the lake filled the fishing has steadily declined, as was only to be expected, in spite of restocking and in spite of every effort to improve the food supply. The rivers on the other hand have of recent years become overstocked owing to lack of anglers, with the result that where one could average half-pounders in 1916, one is lucky now to take a single fish of that weight (fairly weighed and not simply estimated) and the average has dropped to about 4 oz. Everything of course depends on food supply, which is definitely insufficient. Before trout were introduced there were no indigenous fish in the streams of the plateau except a small minnow, and so the balance of Nature has been upset, and so far appears to be beyond re-adjustment. Not but what quite good sport may still be enjoyed, and in my opinion further deterioration is most unlikely.

But, apart from fishing by normal methods, one of my best memories is of some very large murrel shot with a .303 in the pools below the bund of the Khadakwasla lake near Poona in 1910. As is well known these fish have to come to the surface to breathe, and it is then easy to shoot them, provided one aims a few inches low to allow for refraction, and has a man ready to retrieve, for my experience is that they invariably sink. And at Bhamo when the annual floods covered the brigade parade ground, shoals of fresh-water mullet appeared, swimming on the surface with their eyes protruding above water. We tried every normal method of circumventing them without success, so adopted a plan referred to in Thomas's *Rod in India*, and went after them in a boat with our 12-bores. We used No. 8 shot with satisfactory results, and found that not all fish sank when hit—presumably it depended on whether the bladder was pierced. I see from my register that in five 'shoots' we bagged 44. Nothing is mentioned about weight, but to the best of my recollection there were few if any exceeding half a pound. They proved excellent for the table, and I remember in Mess one night my colonel asking me where I had got the fish we had just eaten. When I told him, he was rather annoyed at what he evidently considered ill-timed levity. Perhaps some of my readers will agree with him!

SHIKARIS

These memories would be incomplete without some mention of at least some of the many shikaris I have employed, without whose willing help and co-operation my sport in the jungle would have been very much poorer. A few in my early days no doubt took advantage of my inexperience; such are to be found in every large military station. But the great majority were keen and hardworking, and definitely laid themselves out to do their utmost to ensure success. Stout hearted too, when it came to the push. In fact in all these years, I can remember one only whose nerve gave way—that was when a bear charged in Chanda, as already related.

Out of so many some stand out clearer than the rest. Anthoo in Chanda, one of the finest shikaris in the Central Provinces; Pinnaya at Karachi who helped me to get my first houbara, and who accompanied me on two trips to Las Bela—to this day I remember how he used to curse when his camel stumbled; Diwaji at Poona—I still have the cunning game stick he made for me over 40 years ago. It was intended to hold 20 birds only, but on the first day I used it we managed to make it hold double that number of quail. Then there was Raya Gowda in North Kanara, Ko Po and the thugyi's son on the Kalaw ghat, and the many shikaris I have employed in the Nilgiris during the past 27 years.

Of these, 'Old' Anthony stands out head and shoulders above the rest. Whether it was a tiger or a woodcock he was equally keen, and he would do what none of the present generation are willing to, that is to go out on his own to mark down birds; and when he did report a dozen snipe, one could be sure of finding them. In spite of having suffered a severe mauling by a tiger he was completely fearless, as indeed I have found all the Nilgiris shikaris to be. Arokiasamy was almost equally good, and was with me at the death of several tigers. Both have now passed on.

At Mudumalai, Kempe was similarly outstanding. He knew every inch of the jungles and his knowledge of wild life was unequalled. Many happy days did I spend with him, and have always lamented his untimely death, reputedly by poison. His two younger brothers are still with us, but though good are not in the same class.

When first I visited Anaikatti, Mullah was still alive, but getting too old for active work. He had a great name and had provided tigers for more than one Governor. Jaora was with me for many years and proved first class, but he too has passed on, as also his son Chick Banta, and now only his grandson Mooka remains to carry on the family tradition. Of those still alive I rank Bomma best for big and Kunmada for small game. The way the latter will circumvent a peacock spotted by chance half a mile away and arrange a beat so as to put it over the guns, has to be seen to be believed. All the Anaikatti men are splendid trackers, that goes without saying.

At Cannanore Mohideen Kutti of Palayangadi was first class for snipe. Well do I remember his exhortation to a bird streaking for the horizon 'All right. Sit down'. It was about the only English he knew. Another Moplah at Kakod was even better. I am sorry to say I have forgotten his name. His son Musai Kutti now takes sportsmen out, but though good is not to be compared with the old man, who always used to go out in advance and mark the birds down.

All these will, I am afraid, be mere names to most of my readers, but I feel it only right to record them. Without exception they have proved 'Good companions' in every sense.

I have always been at pains to be on friendly terms with my shikaris. To put it at its lowest, it pays hands down. And it is so easy to learn enough of the local vernacular to find out what is going on, or to crack an occasional joke. A vocabulary of 300 words is ample for all practical purposes and is not difficult to acquire. In some places it is absolutely essential, for instance in Burma, where the average *mokso* will take little interest unless the sportsman can speak to him in his own language. It is also sound policy to engage the best man available, and not to accept a cheaper substitute. This applies particularly to a sportsman visiting an area for the first time. Game animals in India are few and far between and take some finding. That is where local knowledge comes in. Besides there may be some special rules regarding closed areas, and unless you have a reliable man with you, you may encroach on forbidden ground. Definitely it does not pay to go out alone, for even though you think you know the jungle, you may get lost, or a twisted ankle may land you in a very awkward predicament.

SHIKAR FOR THE SERVICES

The importance of encouraging officers to take up shikar cannot be over-emphasised. Recently I was asked by the Madras Regimental Centre to write a short article on the subject, and in hopes that it may be of interest to others, I reproduce it here.

All peacetime training of the Armed Forces is with one ultimate objective only, viz. war. But how often is this essential fact overlooked, and how often are officers satisfied with a minimum of field work? An officer certainly requires a sound theoretical knowledge of his job, but equally important are those qualities which will enable him to put his knowledge into effect, and to fit him in every way to be a leader of fighting men. Such are physical fitness and endurance, self-reliance and perseverance, a spirit of enterprise and coolness in the face of danger, a mind trained to deal promptly with any kind of emergency, e.g. when to open or withhold fire, a knowledge of bandobast in every sense of that most useful word, and above all an eye for country and skill to move quietly through the jungle and unseen over open ground.

How is an officer to acquire these when actual training in the field with troops is, for various reasons, so limited? The answer lies in shikar, which is not only a very pleasant form of recreation, but also practical training for war, since the constant pursuit of big game, which involves much hard work and occasional hazards, will inevitably enable an officer to acquire all the qualifications which I have listed above. There is no need to elaborate them as they are only too obvious. Can there be any doubt that an officer possessing them is of far greater value to his country than one whose amusements seldom take him outside cantonments? Why then do so few officers nowadays take up shikar as compared with 50 years ago, when nine out of ten subalterns possessed a gun or a rifle, and many of them had a pony as well? The chief reasons are, I think, lack of experience and considerations of expense.

As regards the former, it is true that compared with older days, there are now very few senior officers who can pass on to their juniors the knowledge which they themselves have acquired. But the spoken word is, in any case, apt to leave little impression. It is the written word which remains in the memory, and of shikar books there are enough to fill a small library. Some up-to-date ones should be in every Officers' Mess. And these Jungle Memories of mine are written more especially to help the novice by analysis of the mistakes which I have myself made. There should therefore be no difficulty in acquiring a good theoretical knowledge of the subject, after which only personal experience is needed to put theory into practice.

The question of expense is admittedly more difficult, as the cost of weapons nowadays is prohibitive for those with shallow purses. The obvious solution is for Officers' Messes to purchase a couple of shot guns and a rifle, to be hired out to officers wishing to use them. The guns should be 12-bores as cartridges are more easily available, and should not cost more than Rs. 800 each. As regards the rifle, I strongly recommend the .423 or .404 Mauser which should be available for about Rs. 650. Either of these weapons will deal with anything, from a blackbuck to an elephant. I do not recommend smaller bores as they have so little stopping power in the event of trouble with a dangerous animal, nor are the old black powder Expresses desirable, as it is almost impossible to get cartridges for them nowadays.

So much for weapons. Then there is the question of shooting expenses, and these will depend very largely on individual tastes. It is of course a matter of experience, but it is surprising how cheap a trip can be if one is prepared to rough it and not waste money on non-essentials. Sport of some sort with either gun or rifle is to be found within reasonable distance of almost every military station, and motor buses and a pushbike will get one anywhere, with a few coolies to carry the kit. In fact there is no reason whatever why costs should exceed the expense of living in one's station, provided that no long rail journey is involved.

To the young officer anxious to make a start with shikar my advice is first to read and memorise a really good book on the subject, next to ascertain from local officials what facilities there are for sport within reasonable distance, then after obtaining any necessary licence to take a few days leave and try it out. You are bound to make mistakes at first, but don't get downhearted if things go wrong—the most valuable experience of all is gained that way. Be enterprising, and find out things for yourself, and if you work hard your efforts are bound to be crowned with success sooner or later. Shikar consists of bitter disappointments and pleasant surprises. There is a good bit of luck about it, but the chief thing to remember is that success in shikar, as in business and war, will not be achieved without most careful attention to detail.

Finally, since shikar is sport, what exactly do we mean by the latter? Col. Stockley in his book 'Shikar' has given as good a definition as any. 'Sport lies in pitting one's own natural faculties, brain and endurance against those of the game. To shoot animals from a car may be amusing, but it is not sport; it is merely the outcome of laziness'. And the Royal Commission on field sports recently convened in England has defined sportsmanship as 'giving the quarry a fair chance'. That element of sport makes the sole difference between shikar and war. In shikar one exercises some forbearance, but it would be suicide to do so in war.

CONSERVATION

Before bringing these Memories to a close, it may be worth while to look back and consider the changes in sporting ethics during the past

50 years, and their resultant effect on wild life. When I landed in India the standard of sportsmanship was very high indeed, and approximated very nearly to what the Greek writer Arrian wrote 1800 years ago regarding the people of Britain, who he said 'hunt for the beauty of the sport, and consider the killing of the prey to be of minor importance'. Gone, it seemed for ever, were the days of the butchers of the 70's and 80's of last century, whose bloody exploits are so unblushingly detailed in certain old shikar books. The game laws too had been tightened up and were rigidly enforced. In fact it seemed reasonable to assume, without undue complacency, that the future of wild life in India was secure for many years to come.

Then came the two world wars and their aftermath—the disappearance of many who could have passed on the traditions they had inherited, and a general disrespect for law and order. The increasing use of motor cars too, enabled an ever increasing number to indulge in a new form of shikar, and to slaughter animals with a minimum of exertion or risk, subordinating all ideas of sportsmanship to the desire to kill. With India's attainment of independence, matters went from bad to worse. There was undoubtedly a widespread belief (which persists even today) that the game laws in force till then were introduced by alien rulers to serve their own ends, and might now be safely disregarded. Their real purpose, to conserve wild life, was, and still is, completely ignored. Gun clubs were formed in many places, ostensibly for crop protection, but mostly for the high profit to be derived from the sale of meat. With few exceptions everyone possessing a firearm uses it for the indiscriminate destruction of game, regardless of sex or season. Persons without the least experience of shikar fire with buckshot at all kinds of animals, of which many in consequence escape to die a lingering death. If a dangerous animal is not killed on the spot no attempt is made to follow it up, with the result that it becomes a source of danger to some unfortunate villager.[1] The game laws are not adequately enforced, since forest subordinates are in many cases afraid to report poachers lest their families suffer reprisals, or else the social status of the offender ensures his immunity. These things are matters of common knowledge, and it is no exaggeration to say that if the slaughter taking place all over the country continues at the present rate, game animals in India will soon become practically extinct in all but the most inaccessible areas.

They are having much the same trouble in the U.S.A., and the solution there is a nation-wide conservation pledge: 'I give my pledge as an American citizen to save and faithfully to defend from waste the natural resources of my country; its soil and minerals, its forests, waters and wild life'. This pledge, with a badge, and the slogan 'The Game Law Violator is a Thief', is given the widest possible publicity through the press and in other ways. It is being taken by millions of adults, and by school children also, and there is no doubt that it is bringing home to all classes the importance of conservation. If that can be done in the great democracy of the West, why should it not succeed in India also?

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[1] The latest Kenya Game Laws make it obligatory to report the wounding of any dangerous animal. Failure to do so is an offence for which imprisonment (with or without a fine) is *mandatory*.

Unfortunately it is only too obvious that in this country to date, in spite of much propaganda, the real object of conservation is very far from being understood. Otherwise we should not see a so-called 'Wild Life Park', (liberally placarded with notice boards prohibiting all shooting), being used as a regular shooting reserve for State guests and other favoured individuals, or read an article in the press protesting against permission being given to destroy dangerous cow elephants. As if *they* were in any danger of extinction! Or the equally ridiculous idea of making the renewal of an arms licence dependent on the amount of vermin (not specified) which the holder has shot during the previous twelve months.

Wild life is a very real national asset, and no one can object to all reasonable steps being taken for its preservation. But before formulating proposals or taking action which merely brings ridicule on conservation, it would be well if those responsible first consulted experts on a subject of which they themselves apparently have not the slightest knowledge.

CONCLUSION

No excuse is needed for shooting—it is a primitive instinct innate in man, whatever anti-blood-sport cranks may say. But as one gets older, the desire to kill becomes less pronounced, at least that is my own experience. I have often regretted that I was not able to take up animal photography, but my attempts in that line with an ordinary Kodak soon convinced me that successful results can be obtained only by the use of expensive apparatus. As that was beyond my means I had to give up the idea.

In this series I have indulged in no flights of fancy, but have given a true and unvarnished account of my experiences in the jungle, in the hope that the mistakes I have made and the knowledge which I have, at times so painfully, acquired may be of use to others. Except in a few specific cases I have refrained from giving the measurements of trophies, because it has always seemed to me undesirable to introduce the idea of competition into shikar. After all what does it matter whether one's best head is half an inch larger or smaller than some one else's, provided it is a really good trophy? And of course in the case of tigers and panthers so much depends on the length of the tail. Nor have I the least desire to pose as a great shikari. There must be other members of our Society with far more experience of big game than myself, and I trust that some of them will be encouraged to follow my example, and give our *Journal* the benefit of their own memories of the jungle.

Shikar is the salt of life, and if I have managed to convey to my readers a tithe of the happiness I have myself found in the jungle, I shall have accomplished my object.

(*Concluded*)

RACES OF THE INDIAN GIANT SQUIRREL (*RATUFA INDICA*)

BY

HUMAYUN ABDULALI AND J. CYRIL DANIEL

(*With a plate*)

In October 1950 H.A. was at Bhimashankar, Poona District, (19°5′ N. × 73°30′E) about 25 miles north-north-east of Khandala, and was struck by the large amount of the white in the tail of the several giant squirrels observed by him there. Upon returning to Bombay he examined specimens in the Society's collections, and from the literature available it appeared that there was something unusual about the squirrels seen. On the 16th April the place was revisited with Sálim Ali and two specimens collected. The base of the tail blended in coloration with the rump and hind legs, and there was actually more brown at the base than had been apparent on first sight. H.A. and J.C.D., however scrutinized all the specimens in the Society's collection with the help of the literature available, and the following results appear to be worth recording.

Six races have so far been described in India as follows:

1. *R. i. indica:* Erxleben 1776

Type locality: "Bombay Presidency".

Racial characters: Body colour brown throughout, with underparts yellowish and forehead clay coloured. Tail same colour as body with pale tip.

Blanford (1897) portrays a hazel specimen with about a third of the tail white.

Wroughton (1910) states that the animals from the north of Poona are hazel in colour while those from the south of Poona are bay.

The two specimens from Bhimashankar are hazel and both Humayun Abdulali and Sálim Ali, who had a look at several specimens in the field, are sure that all the animals seen at Bhimashankar were of this colour. Eleven specimens examined from Khandala were bay with slight variations in colour while one (B.N.H.S. Col. No. 6294; collector Br. Novarro, September 11, 1951) almost matches the Bhimashankar hazel.

Fourteen specimens from Khandala have the pale tip to the tail ranging from 30% to 52.5% of the whole length of the tail (average 43·2%). The two from Bhimashankar have 50·25 and 50·4% of the tail white respectively.

Twelve specimens from the southern part of the Bombay Presidency, Samasgi, Devikop and Kadra on the Kanara border, are bay and agree with the eleven from Khandala referred to above. One specimen from Devikop (B.N.H.S. Col. No. M. 51, November 22, 1911) is slightly lighter in coloration.

Eleven specimens from the south have much less white in the tail ranging from 15·75 to 33·3% (average 24·65%).

One shot and examined by Humayun Abdulali at Mahableshwar (October 1951) appeared to be identical with skins from Kanara.

With reference to the amount of white in the tail, it might be explained that in all the specimens the reddish-brown of the rump gradually diffuses into white towards the tip, and it is not possible to determine where exactly the white starts. The measurements were taken from intermediary positions and to this extent are somewhat arbitrary, though consistent.

Among the skins from Khandala one has a black patch at the base end of the tail (B.N.H.S. Col. No. 6286) and three are black on the upper foreleg (Nos. 6286, 6287 and 6296).

Of the specimens from south Bombay, two females (M. 1328, September 1940, and M. 46, March 14, 1912) and a male (M, 56, March 1912) from Karwar Head and Samasgi, Kanara border, have distinct black patches where the foreleg meets the shoulder, there being more black on the upper arm than on the shoulder. Specimens with no black patches have, however, been obtained from the same camp. A juvenile from Samasgi (1278, March 15, 1912) is bay all over. The black on the forearm is therefore not a constant character though it shows a tendency towards *centralis.*

From the above it appears that the specimens from Khandala and Bhimashankar can be separated from those from southern Bombay State (as far north as Mahableshwar) by the larger amount of white in the tail. The two former are also separable *inter se* by their coloration—hazel at Bhimashankar, bay at Khandala. Sykes, in the original description of *elphinstonei* (*P.Z.S.*, 1831, p. 103–'Western Ghats') stated that half the tail was reddish chestnut and the other half a fine reddish-white. Wroughton also suggested that if the forms from north and south Bombay should be found to be different, Sykes's name *elphinstonei* would stand. This name would thus be applicable to the Bhimashankar form, while should the Khandala type prove to be sufficiently constant it would require another name.

A draft copy of this paper was sent to the British Museum for comments and Mr. R. W. Hayman suggested the possibility of a seasonal change being responsible for the differences in colour. Of *indica* we have 8 skins collected at Khandala in September and May which show no difference in colour. The hazel skin from Khandala was obtained in September as compared with April for Bhimashankar. Specimens of the other races in the B.N.H.S. collection are also spread out over different months of the year. There is nothing to indicate any seasonal change in coloration.

2. *R. i. dealbata* Blanford* 1897.

Type locality: Surat Dangs.

Habitat: Moist deciduous forest.

The body colour is cream buff with the tail paler. Ear tufts brown.

Wroughton in 1910, opined that this extraordinary race was extinct, but recently several specimens were obtained from Songadh and

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* In the 'Checklist of Palaearctic and Indian Mammals (1758 to 1946)' by J. R. Ellerman and T.C.S. Morrison-Scott London (1951) it is suggested that *dealbata* is possibly based on albinistic individuals of *Ratufa indica.* In view of the fresh specimens recently obtained at different places in the Surat Dangs area there can be no doubt that it is a good race.

Mheskatri in the Dangs by Sálim Ali (1948) who reports it to be not uncommon though patchily distributed. The specimens from Mheskatri are tinged with grey at the base of the tail and are brownish on the rump.

3. *R. i. superans* Ryley 1913.

Type locality: Wotekalli, South Coorg (West of Brahmagiris).

Habitat: Evergreen forest.

This is described on its appreciably larger size, the colour being identical with that of the bay *indica* from Kanara.

Messrs. C. J. Leslie and A. F. Hutton of Kadamane Estate, Hassan District, Mysore, have recently sent us three specimens which measure:

Head and Body:	500, 470 and 420 mm.	(340 to 380 mm.)
Tail	500, 520 and 510 mm.	(370 to 446 mm.)
Length of skull	79, 79 and 78 mm.	(68 to 74 mm.)

The figures in parenthesis indicate the measurements quoted by Ryley for *indica*. It would appear that on measurements these specimens are *superans*, extending the known distribution of the race appreciably northwards.

4. *R. i. bengalensis* Blanford 1897.

This is an unfortunate name. The type locality is not known and the specimens collected by the Society's Mammal Survey at Huwinakadu Estate, Kutta in South Coorg have been identified as of this race. In size it is equal to *superans* and identical with it in colour except that the tail is black with a pale rufous tip.

This race was only known definitely from the jungles on the eastern side of the Brahmagiris in Coorg. We have recently received two specimens (tails 390 mm. and broken) from Wynaad, Nilgiris, from Mr. A. F. Hutton which agree with this form in colour. Another from the confluence of the Segur and Mavinhalli rivers, north Nilgiri Wynaad 2,500 ft. (tail 490 mm.) and a third from Lovedale, Ootacamund, 7,300 ft. (tail 380 mm.)—both obtained by Capt. K. Boswell—are similar except that these have black patches on the upper forelegs. The presence or absence of this character seems to be of no significance in *indica* and it is possibly the same in *bengalensis*.

A fourth specimen from Kotagiri (C. Primrose, Rookery Estate, Kotagiri, Nilgiris) is marked *maxima* but has a white tip to the tail (480 mm.) rendering this identification inadmissible. The black of the upper arm extends to the shoulders as in *centralis*. The fur is also exceptionally long. A note by C. McCann on the index card reads 'this seems to be intermediate between true *maxima* and *bengalensis*.' Specimens obtained by the Mammal Survey at Kotagiri are said to be *centralis* (*J. B. N. H. S.*, XXVI, p. 1033). Mr. R. W. Hayman of the British Museum, who has kindly re-examined them in London states that 'they are *centralis* in colour, but the measurements appear to overlap those of *bengalensis*'. *

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* Ellerman & Morrison-Scott (1951) state that *centralis* occurs in the Nilgiri Hills apparently at localities different from where *R. i. maxima* is found.

Another obtained by A. F. Hutton in the Annamallais, 20 miles north-west of Valparai on the Cochin border is near *bengalensis* (tail 480 mm.) but shows a tendency towards *maxima* and/or *centralis*, a thin black line extending from the rump half way towards the shoulder together with prominent black patches on the forearm.

The presence of black on the upper forearm in several of the Nilgiris skins does suggest *centralis*, but though slightly smaller in size they appear to be nearer to *bengalensis*. Measurements have been restricted to the tail as head and body measurements in flat skins are difficult. A few of the skins examined are chrome-tanned and the hair appears to have a much higher gloss than in the other skins.

5. *R. i. maxima* Schreber 1788.

Type locality: Malabar.

This form is bay coloured with the upper-arm, shoulder, rump and tail black and with a median black dorsal line in most cases. The tail is completely black with no pale tip, but with a thin line of rufous running along the length of the lower surface. The only adult in the Society's collection from Tenmalai, Travancore, is also distinguishable from the other races by its white forefeet (as against rufous of varying shades), the relative paleness of the hind-feet as compared to the body, and by the head being concolorous with the bay on other parts of the body (not grizzled or darker as in the other races.)

The Mammal Survey (*J.B.N.H.S.*, XXXI, p. 595) recorded this race from the High Wavy Mountains and Cotengady Estate, Annamaad and Ottacoolie Estate in the Nelliampathi Hills (Palghat District). It was also obtained in the Palnis.

Mr. Hutton who has been of considerable assistance in obtaining specimens from South India has provided 3 more skins, two (including a juvenile) from the High Wavy Mountains and one from '6500 feet up in a small shola in the Grass Hills half-way between the Annamallais and the High Range.' These skins have all the characteristics of *maxima* including the additional distinguishing features mentioned above.

It is not quite clear from the material available where *maxima* meets *bengalensis*. A skin from the Annamallais on the Cochin border has been referred to as *bengalensis* while another from the Grass Hills further south is typical *maxima*. The dividing line would lie somewhere in between, and it would be interesting to attempt to associate this with some physical boundary. Mr. Hutton states that he has not seen *maxima* below 3000 ft.

The two forms mentioned by Hutton in his paper on 'The Mammals of the High Wavy Mountains' (*J.B.N.H.S.*, 48, p. 691) appear to be covered by the known variations in *maxima*.

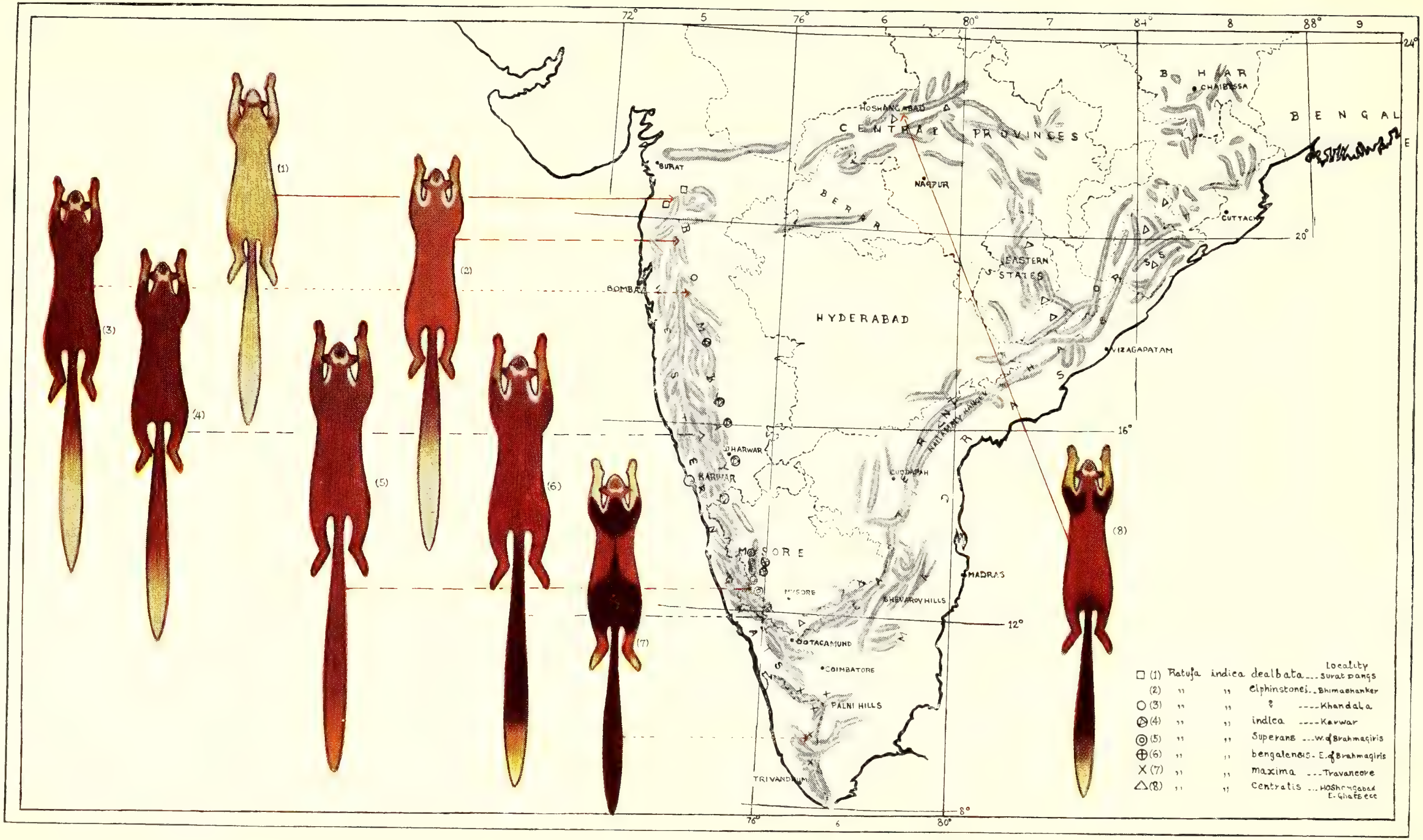
McCann (*J.B.N.H.S.*, XXXI, p. 595) notes that 'the cry of this race is much sweeter than that of the ordinary *Ratufa*', presumably referring to animals from Khandala with which area he was familiar.

6. *R. i. centralis* Ryley 1913.

Type locality: Bori, Hoshangabad District, C.P.

Habitat: Moist and dry deciduous jungle.

This was originally separated from *bengalensis* on its smaller size and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NAGPUR
SURAT
BERAR
EASTERN STATES
HYDERABAD
BOMBAY
VIZAGAPATAM
DHARWAR
KARWAR
CUDDAPAH
NALLAMALAI HILLS
MADRAS
MYSORE
SHEVAROY HILLS
OOTACAMUND
COIMBATORE
PALNI HILLS
TRIVANDRUM
Locality
□ (1) Ratufa indica dealbata ... Surat Dangs
(2) ,, ,, elphinstonei .. Bhimashanker
○ (3) ,, ,, ? ---- Khandala
(4) ,, ,, indica ---- Karwar
◎ (5) ,, ,, superans --- W. of Brahmagiris
⊕ (6) ,, ,, bengalensis - E. of Brahmagiris
X (7) ,, ,, maxima --- Travancore
△ (8) ,, ,, centralis ... Hoshangabad E. Ghats ecc

Races of the Indian Giant Squirrel (*Ratufa indica*).

the distinction of having black patches on the shoulders and occasionally on the rump. 19 specimens measure:

Head and body ... 300–380 mm; average 340 mm.
Tail ... 390 (270 exceptional) to 450 mm.; average 405 mm.

This form extends through the Central Province (Madhya Pradesh) northwards into Orissa and Bihar and then south along the Eastern Ghats as far as South Arcot and Chamarajnagar in Mysore State (hardly 30 miles from the locality of *bengalensis* in Coorg). The Survey also records it from Coimbatore and Kotagiri (see *supra*). There is an appreciable amount of variation in the amount of black in this form, being at times restricted to the upper arm to the extent found in *indica*.

It also shows variation in the depth of coloration. Four skins, Balapalli Range, South Cuddappah (2); Lamarsinghi, Vizagapatam District; and Dhain, Hoshangabad District are bay, similar to *indica* from Kanara. Others, including skins from Dhain and Lamarsinghi, are darker, and though the evidence is unsatisfactory there is a suggestion of lightness in colour towards the south.

17 out of the 22 skins examined have black tails with small pale tips. Five (2 Chaibassa, Orissa; 1 Lamarsinghi, Vizagapatam District; 1 Antagarh, Bastar District; 1 juvenile Bori, Hoshangabad District) have reddish brown in the tail between the black base and the pale tip. This may perhaps be associated with the tendency to darkness towards the north.

One specimen from Chota Dongar (Bastar State) has an all black tail. While no sign of injury is now visible, the tail is shorter than the body—which is against the general rule for the species—and it must be assumed that the pale tip was accidentally broken off at some stage.

As this species is localized with little or no chance of overlap between different populations it is possible that some of the differences mentioned above are constant.

SUMMARY

(i) An examination of freshly collected material and scrutiny of data shows that *R. indica* from Khandala and Bhimashankar differ from those in south Bombay State in the amount of white in the tail. Specimens from Bhimashankar are hazel as compared with bay in the south and at Khandala, and may therefore be attributed to the form designated *elphinstonei* by Sykes. The form from Khandala seems intermediate, but may merit separation from that occurring at Bhimashankar.

(ii) *R. i. dealbata* is not extinct and still occurs in the Dangs.

(iii) Several races meet in Mysore and the Nilgiris and their distributional limits are not very clear.

(iv) *R. i. centralis*: Populations from the north-eastern part of its range are distinctly darker than those from the southern, though both types have been collected in the type locality which unfortunately seems to be an intermediate area. Some individuals from the northern range also have rufous in the tail.

(v) *maxima* differs from the other races in its white forefeet and the forehead being concolorous with the rufous on other parts of its body.

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A COLLECTION OF BIRDS FROM THE NAGA HILLS

BY

S. DILLON RIPLEY

(With two maps, two coloured and two black-and-white plates)

During the summer of 1950 my wife and I arrived in India hopefully looking forward to a project which we had cherished for some time in common with Mr. Sálim Ali, namely to visit the eastern Naga Hills, and perhaps to attempt to climb Mt. Saramati (12,553 ft., a.s.l.) which lies almost directly east of Kohima, the Deputy Commissioner's headquarters, on the India-Burma border. Saramati has never been climbed by a naturalist, or so far as I know by any non-Naga (although a Karen in the Burma Cartographic Survey is alleged to have climbed it in 1935), and it is the highest summit in southern Asia south of the Himalayas, excluding the Islands.

The Naga Hills have had no intensive visits by naturalists. Major H. H. Godwin-Austen visited the Hills during 1872-73 and reported the novelties discovered by him in the *Proceedings of the Zoological Society,* 1874, Pt. 1., pp. 43-48, with several fine coloured plates of some of the distinctive forms such as *Garrulax galbanus* and *Actinodura nipalensis waldeni.* The comprehensive paper by Hume on the birds of Manipur (1888) includes many notes of the occurrence of birds in the Naga Hills, usually furnished by Godwin-Austen, or from the collections made by two other surveyors associated with him, Messrs. Ogle and Chennell. However, there has been no general paper of any kind. In the case of mammals there have been isolated notes from time to time, mostly from the pen of J. H. Hutton and J. P. Mills, both distinguished former Deputy Commissioners.

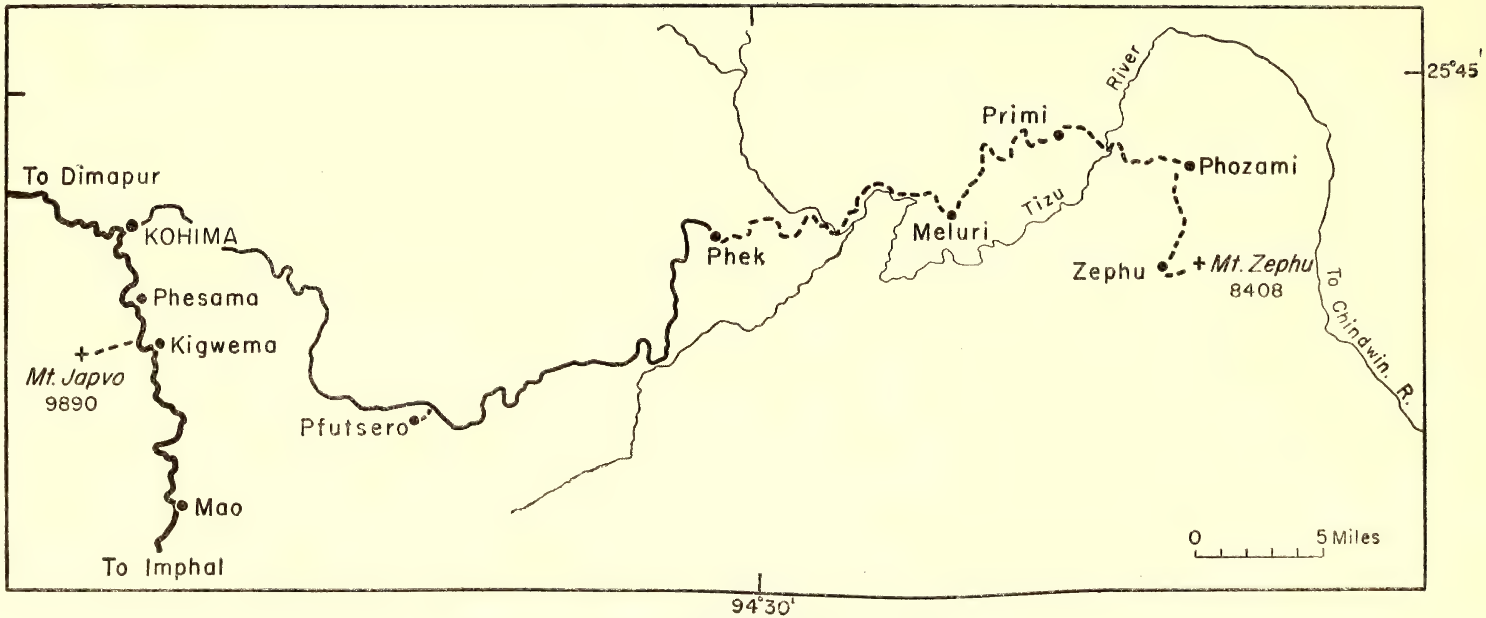
Unfortunately Mr. Sálim Ali was unable to come with us in the end, and in the meantime the great Assam earthquake had necessarily diverted the facilities of Government, so that it was found to be impossible to lend us the escort of Assam Rifles which by Government Regulation we would need to visit the unadministered territory of the extreme eastern Hills. We arrived at Kohima in October, however, to find that the Deputy Commissioner, Mr. S. J. Duncan was extremely conscious of our disappointment and graciously made every effort to afford us 'second best', and make our visit as profitable as possible in the short time that we stayed in the Hills.

After a brief stay in Manipur from October 17-25, we returned to Kohima and were allowed by Mr. Duncan to arrange for a trek up Mt. Japvo, the highest peak of the Barail Range (9,890 ft.) which lies about 5 miles southwest of Kohima in an air line. The Barail Range is a massive feature thrusting in a north-easterly direction, composed of slate and shale with heavily wooded peaks lying both in north Cachar and the western Naga Hills. We were able to leave for Japvo on November 2 and to stay there until the 13th. We made our camp at 7,700 ft. under a thick canopy of original tropical evergreen rain forest, climbing up to the ridge at 8,500 ft. and the peak beyond each day, or plunging down into the lower slopes. Birds abounded but were difficult to see and collect due to the great height of the trees, and the density of the undergrowth wherever trees had fallen, and small clearings occurred. Most of the small birds were in vast hunting parties at all stages in the forest, from the tree tops, through the understoreys of lower trees, higher bushes, and finally the lowest level of strobilanthes, ferns, nettles, and rotting brush resting on the ground. Serow, barking deer, sambar, wild dogs, tiger and possibly goral were all noted in one way or another. The only smaller mammals seen were two species of Tree Squirrel belonging to the genera *Dremomys* and *Tamiops*.

Returning to Kohima my wife had unexpectedly to leave suddenly for the United States, but meanwhile permission had been granted by the Assam Government for us to visit the extreme eastern Hills, as far east as we could go and still remain within the administered area. This would allow us to go right up to the Burma border in one small area where the Tizu River, a tributary of the Chindwin, flows through a gap in the main north-south axis of the Naga-Patkoi Range just south of Saramati. Not far from the trail which lies along the course of this river is a small mountain, Zephu, (8,408 ft., a.s.l.) which I felt would afford us an opportunity to sample the montane fauna of these eastern Hills.

Consequently I made preparations to go on east, accompanied this time by Mr. Horace Alexander and Professor D. C. Mahanta of Gauhati University. We started this part of our trip on November 18th in a heavy downpour of rain in two wartime Dodge weapons carriers or 18 cwt. four-wheel drive trucks. The first 54 miles of the trail east from Kohima to the eastern Angami village of Phek is motorable (Phakekedzumi is an alternate spelling of this village on the quarter-inch Survey of India Maps, Sheet No. 83 K), although 'motorable' seems a charitable word especially if the weather is unseasonable (*N.B.* November and December are technically known as the 'dry' months in the Naga Hills). Farther east there is a trail which was probably jeepable during war-time, but has now become impassable for vehicles due to the demise of all the steel cable suspension bridges and the substitution for them of the locally-made rattan cane pedestrian suspension bridges. We continued along this trail to Meluri, Primi (called Akhegwo on some maps), and Phozami (called Yisi on some maps), the latter some 93 miles by trail from Kohima and 15 miles from the Burma border.

At this point Professor Mahanta and I (Mr. Alexander's holiday had come to an end and he returned to Delhi), left the trail and struck south some 9 miles or more to Zephu where we made camp 200 ft. below the summit and remained only four days until December 1st. This point is about eight and a half miles from the nearest point on the Burma border. It was cold on Zephu, the temperature hovering in the low forties (F.) during much of the day, with several degrees of frost at night. The Nagas disliked the cold and remained in the nearby Sangtam Naga village of Zephu (7,000 ft.) as much as they could. Zephu, like Japvo, was all untouched tropical evergreen forest, with the addition of more types of hill bamboo than we had seen on the Barail peak. Only above 7,000 ft. is there likely to be unspoiled evergreen forest to-day in the Naga Hills, so great is the



Map of the Naga Hills showing our route.........

extent of the shifting cultivation. The effect is almost of 'islands,' as the patches of unspoiled jungle are often quite isolated from each other.

We reached Phek again December 5th, Kohima December 11th, and I left the Naga Hills December 12th. We thus had a total of 48 days in the Naga Hills during which we managed to collect 743 specimens representing 196 species and subspecies. In addition we saw, but did not collect, at least five species (I have not listed an owl and several hawks whose identification would be problematical), making a total of 201 species identified in the field.

With the exception of our two visits to heavy undisturbed evergreen forest on the summits of Japvo and Zephu, our collecting was mainly confined to what is now the predominant biotope in the Naga Hills from the lower altitudes of 2,000 ft. up to 7,000 ft. This is cut-over scrub mostly of a deciduous type which may be firewood lots for the Naga villages, sometimes second growth from old agricultural clearings, sometimes patches of scrub jungle near villages kept by the Nagas for toilet areas. In these somewhat unpromising surroundings there is often a wealth of bird life due to the fact I suppose that birds may be moving from one jungle area to another, or that particular shrubs or trees may be in flower. Much of the thick tangle of light jungle is of course very suitable for babblers, and they were always in evidence. Larger species like hornbills, pheasants, eagles, and the large owls were much less in evidence, however, and there is no doubt that the destruction of the forests here is having a decisive effect on the numbers of different species. Some species will decrease sharply, others increase, and a survey of the fauna in this area in another few years should prove illuminating.

Attempting to assess the fauna as a whole I was interested to note that out of 125 species which could be divided into more predominantly western or eastern-derived forms, 54 species of these Hills were of the same species as those farther to the west in the Himalayas proper, while 28 were of Burmese or Indo-Chinese origin. The other 43 were either endemic species or subspecies whose origin either from the west or east was uncertain. Thus 65 per cent of the endemisms studied by me seem to derive from the western, the Himalayas fauna, and only 35 per cent from the Indo-Chinese fauna, a smaller proportion than I had expected before I visited these border Hills.

There are only two good endemic species in this area apparently, both shared with Manipur, *Tragopan blythi* and *Garrulax galbanus*. Of the endemic subspecies 27 seem to be confined to this immediate area or shared with Manipur (17), the Patkoi Hills (7), or Cachar (14). Many of these endemisms run south as far as the Chin Hills (Mt. Victoria) (9). I am certainly sorry we did not get a chance to collect on the higher slopes of Saramati which we could see plainly from Meluri east along the trail. The upper 3,000-4,000 ft. appear to be grassland, and there should possibly be a wren, *Troglodytes*, a *Babax*, possibly a Nutcracker, and probably a Yellow-billed Blue Magpie on the upper slopes. But this problem will remain for another attempt. I certainly wish much luck and God-speed to the ornithologist who visits that challenging mountain.

Some of the novelties collected by us have already been described by me in *Postilla*, a publication of the Yale Peabody Museum (no. 6, 1951). My grateful thanks are due to the authorities of the British Museum, the United States National Museum, the American Museum of Natural History, the Museum of Comparative Zoology at Harvard, and the Chicago Natural History Museum who have lent me specimens in their care, or allowed me to work in their Bird Rooms. I am grateful for some financial aid received from a Fulbright award of the U.S. Government. For help in the field I am most grateful also to Mr. and Mrs. Duncan of Kohima, to many Naga friends, to Horace Alexander, and finally to my wife Mary, who was a constant aid and source of inspiration.

LIST OF THE SPECIES

PHALACROCORACIDAE

Phalacrocorax carbo sinensis (Shaw) : Large Cormorant.

A flock of 31 was counted on an evening flight up the Tizu River near our camp between Meluri and Phek, December 4th. The Assam Rifles and the Phek Nagas consider these birds to be 'ducks' and shoot them for food from time to time.

ARDEIDAE

Cattle Egrets (*Bubulcus ibis*) seemed to be the only common egret in the areas we visited. Flocks of egrets, presumably this species, were seen flying south over Kohima in mid-November evidently on migration.

CICONIIDAE

Anastomus oscitans (Boddaert): Open-bill Stork.

A single bird was secured out of a flock which landed near the Deputy Commissioner's office building in Kohima evidently lost as there was heavy cloud all over the ridge. The date was in the first week of November. Presumably the birds were on migration as the rest of the flock flew south after the clouds lifted.

ACCIPITRIDAE

Accipiter nisus nisosimilis (Tickell): Sparrow Hawk.

A male was shot November 17th out of a pine tree behind the Circuit House in Kohima. It seemed to be a migrating bird.

Very few hawks were seen, and those that occasionally were glimpsed through the trees could not be readily identified.

FALCONIDAE

Falco tinnunculus interstinctus McClelland: Indian Kestrel.

A male collected at Kohima, October 26th, was the only specimen we secured of this species which was very common in open areas all up and down the Naga Hills.

PHASIANIDAE

Lophura leucomelana lathami (Gray): Assam Kaleej, or Horsfield's Kaleej.

Common from 2,000 to 5,000 ft. in the Naga Hills. Males with varying amounts of white on the rump sometimes were brought in to the Kohima market. Some males closely approached *moffiti*, (*see* Delacour's discussion, 1951), as did some females, in possessing a nearly black rump and very dark plumage. A possible range for *moffiti* may be in the Sylhet area west of the Naga Hills, if the specimens obtained by us represent a trend in the direction of the all-black form. A bird dealer in Calcutta informed me that the shipment of Kaleej pheasants sent to London in the spring of 1950 which included a male *moffiti*, came from north-eastern East Pakistan not far from where the Barail Range of Cachar debouches into the plains of Sylhet.

Tragopan blythi blythi (Jerdon): Blyth's Tragopan.

Blyth's Tragopan is not uncommon on the slopes of Mount Japvo about 8,400 ft. in moss forest. Our Naga helpers assured us that the birds are very fond of certain ferns and showed us many stripped fronds of a rather coarse branching bracken-like species growing in the under-storey. The species from our experience is very local, confined to thick forest, and partially migratory, moving up and down the slopes presumably in search of favorite foods. With the great destruction of forests in the Naga Hills due to shifting cultivation practices, it would seem likely that the range of this species will be fragmented into isolated colonies, if this has not happened already. We could not obtain any information about the species in the eastern hills, where it apparently does not now occur.

A male from near Khonoma on the northern flank of the Japvo complex has a wing measurement of 263 mm. and a culmen of 25.5, considerably longer than that given by Delacour (op. cit. 1951, p. 68). Presumably his measurement is of the bill from the nostril, rather than the culmen as stated.

No specimens of Mrs. Hume's Pheasant (*Syrmaticus humiae humiae*) were secured although we heard something of them. Local information indicated that they are quite as spottily distributed as the tragopan, and now found only in isolated patches of scrub oak forest from 4,000 to 6,000 ft. In the southern Naga Hills they are confined to the Manipur side of the Kohima-Imphal Valley south of Karong, and to a few places in the hills south of Jessami, a village nearly 30 miles as the crow flies east and slightly south of Kohima.

Bambusicola fytchii hopkinsoni Godwin-Austen: Bamboo-Partridge.

A foothill species found in open scrub and pasture land up to 5,000 ft. Birds were moulting in October.

The guttural rolling call of Peacock Pheasants (*Polyplectron bicalcaratum*) was heard along the banks of the Tizu river at about 1,000 ft. altitude east of Meluri, but no specimens were collected. In connection with this species, I have re-examined the two fans of Peacock Pheasant feathers collected by me in the Mishmi Hills in 1947, and mentioned in Delacour (op. cit., 1951, p. 289). I have also borrowed a pair of Gray Peacock Pheasants from the British

Museum collected in the Fort Hertz area of extreme north Burma by Ronald Kaulbach in 1938. These specimens show a cline toward the very dark coloration of the tail feathers shown in my Mishmi fans, but can still be placed with typical *bicalcaratum*. I had hoped that these specimens collected from the hills south-east of the Mishmis in the upper central drainage area of the Irrawady, might belong to this same saturated population, but they only point toward it.

Arborophila torqueola interstincta Ripley: Hill-Partridge.

The Hill-Partridge was only found by us on the upper slopes of Mount Zephu at over 8,000 ft. On comparison in the United States I found that these birds agreed with those from the upper Chindwin River area of Burma in being more richly and darkly coloured and more heavily barred than *torqueola* of the Sikkim Himalayas.

The birds were silent during our stay on the mountain in late November and early December, only occasional low calls being heard. They were unsuspicious, however, and easier to stalk than in my previous experience, scratching busily among the leaves in growths of light bamboo under the oak over-storey.

Arborophila rufogularis intermedia (Blyth) : Arrakan Hill-Partridge.

A single male was collected on Mount Zephu in identical biotope with *torqueola*. Soft parts: iris brown; ocular skin pinkish-red; bill black; legs anteriorly light brownish-pink, posteriorly yellowish-brown.

TURNICIDAE

Turnix tanki blanfordi Blyth: Burmese Button-Quail.

A female with a wing measurement of 101 mm. was taken at Kohima. Iris pale yellow; bill, upper mandible brown, lower and gape dull yellow; feet dull yellow. Weight 63 gr.

CHARADRIIDAE

Charadrius dubius curonicus Gmelin: Eurasian Little Ringed Plover.

A female, evidently in passage, was taken at Kohima, October 15th. Weight 30 gr.

COLUMBIDAE

Sphenurus sphenurus sphenurus (Vigors): Wedgetailed Green Pigeon.

Relatively common from 3,750-7,700 ft., in substage, cut-over scrub and high up in original forest. Soft parts: iris pinkish, inner blue ring; bill basally blue, distally gray; feet cherry red.

Ducula badia griseicapilla Walden: Grayheaded Imperial Pigeon.

A pair were taken at Phek in a patch of jungle on top of a near by hill at 6,000 ft. Iris gray; bill basally coral, distally brownish-horn; feet coral.

Columba pulchricollis Hodgson: Ashy Wood-Pigeon.

A female, one of a pair in a bamboo clump, was shot as it rose from the ground with a clap of wings, on Mount Zephu at 7,000 ft., December 1st. Iris gray; bill basally purplish, distally dull pea green; feet splotched dull red on white. Wing 198.5 mm.

I saw a flock of *Columba punicea* near Phek in cut-over scrub but was unable to secure a specimen.

Streptopelia orientalis agricola (Tickell): Burmese Rufous Dove.

Uncommon in the Naga Hills, perhaps due to the proclivities of the Nagas. Birds were in breeding condition in late October.

Streptopelia chinensis suratensis $\gtrless$ **edwardi**: Spotted Dove.

Baker (1928, p. 243) notes that birds from Cachar and Manipur are intermediate between *suratensis* and *tigrina*. I would prefer to align the specimens collected by us somewhere between *suratensis* and *edwardi* of North Lakhimpur (*see* Ali and Ripley, 1948, p. 13). In the reduction of the terminal spots on the back they are as Baker writes (loc. cit.) approaching *tigrina*, but the tone of the upper plumage is dark approaching *edwardi*. In size, males have wing measurements from 143-146 mm., and weighed from 120-125 gr. Males and females were in breeding condition in mid-October, and a male with slightly enlarged gonads was taken November 22nd.

Macropygia unchall tusalia (Hodgson): Bartailed Cuckoo-Dove.

We collected two females of the Cuckoo-Dove in occasional patches of evergreen forest standing in the ravines leading down to the Tizu River on the trail between Phek and Meluri. The altitude ranged from 2,500 to 3,000 ft.

Chalcophaps indica indica (Linnaeus): Emerald Dove.

A juvenile female was collected on Mt. Zephu November 28th at 7,500 ft. Weight 98 gr.

PSITTACIDAE

Psittacula himalayana finschi (Hume): Burmese Slatyheaded Parakeet.

Two adult females were taken out of fig trees in open deciduous forest along the Phek-Meluri road between 2,500 and 3,500 ft. Wing 147.5, 150 mm. Weight 112, 115 gr.

Psittacula alexandri fasciata Müller: Redbreasted Parakeet.

A pair were taken at 2,000 ft. out of fig trees feeding in a flock as with the preceding species. Wing ♂ 171, ♀ 155 mm.

CUCULIDAE

Cuculus sparveroides sparveroides Vigors: Large Hawk-Cuckoo.

A female from Kohima has a wing measurement of 225 mm.

Rhopodytes tristis tristis (Lesson): Large Greenbilled Malkoha.

Two males from the Naga Hills have wing measurements of 164.5, 167, tail 381, culmen 31, 32 mm. Weight 135 gr. These birds approach *saliens* Mayr, although not as much so as the virtual intermediates from the north in the Mishmi Hills.

STRIGIDAE

Otus scops sunia (Hodgson): Indian Scops Owl.

A rather rufescent male with a wing measurement of 146 mm. was taken at Kohima. Weight 79 gr.

Glaucidium cuculoides austerum Ripley: Eastern Himalayan Barred Owlet.

Two females taken in the eastern part of the Naga Hills prove to belong to this large dark race. Their wing measurements of 161 and 162 mm. are, however, larger than any given by me in my review of the species (1948). In tone, these birds are strongly rufescent. The bill measurement is 15 mm. (2). They thus extend the range of *austerum* south from Margherita along the Patkoi Range to the east Naga Hills.

Glaucidium brodiei brodiei (Burton): Collared Pygmy Owlet.

A male was taken at Phek. Weight 53 gr.

CAPRIMULGIDAE

Caprimulgus macrurus ambiguus Hartert: Jungle Nightjar.

A pair taken at Mao by Nagas for food and sold to us, are very dark in tone and large, wing ♂ 209.5, ♀ 204.5 mm., and therefore presumably belong to this race.

TROGONIDAE

Harpactes erythrocephalus erythrocephalus (Gould): Redheaded Trogon.

A male from Phek has a wing of 142 mm. and weighed 110 gr. We saw trogons from 4,000-5,000 ft. in the east Naga Hills in thick low secondary oak scrub, as well as in high forest.

MEROPIDAE

Nyctiornis athertoni athertoni (Jardine & Selby): Bluebearded Bee-eater.

A female taken along the Phek-Meluri road measures: wing 136, tail 129 mm.

BUCEROTIDAE

Aceros undulatus ticehursti (Deignan): Northern Waved Hornbill.

A male with the casque indicating that it was a young bird was shot at Phek in the patch of evergreen on top of a nearby hill at

6,000 ft. Several immensely tall trees stood out over the surrounding ones and served as perches for a group of a dozen of these hornbills who performed a morning and evening flight to and from the roost. Their majestic procession was punctuated with the sound of their wings, a rhythmic beat sounding like the puffing pant of a steam engine headed up a long, hard grade. On the slopes of Japvo we also saw and heard these birds without obtaining a specimen. From time to time they would dive abruptly to lose altitude, and the sound on these occasions was very much like the 'whooosh' of a jet plane.

Soft parts: iris dull orange, inner ring white; ocular skin dark pinkish-yellow; bill basally reddish-horn, distally whitish-ivory; gular skin orange-yellow with a median transverse band, blackish in colour; feet black, pads dirty yellowish-white.

CAPITONIDAE

Megalaima virens magnifica Baker: Assam Hill Barbet.

A male and two females from Phek have wing measurements of, ♂ 142.5, ♀ 146, 148 mm. At our Japvo camp the Nagas claimed that this was the bird which occasionally punctuated the night with a wild and awful series of shrieks, moving rapidly from perch to perch among the high trees overhead. It would seem more likely to have been an owl, but my searches failed to produce the bird.

Megalaima franklinii franklinii (Blyth): Goldenthroated Barbet.

A male from Japvo weighed 77 gr.

Megalaima asiatica asiatica (Latham): Bluethroated Barbet.

Birds from Phek weighed, ♂ 90, ♀ 87, 88 gr.

INDICATORIDAE

Indicator xanthonotus fulvus Ripley: Eastern Goldenbacked Honeyguide.

A single specimen, the type of this subspecies, was taken near Pfutsero. It agrees with a single specimen from Burma collected by Smythies and reported on in my original description (1951). These birds seem to be found only near wild bees' hives on cliffs, and perch quietly in the tallest trees, so that they are very difficult to observe. The Angami name is 'Mephi Tsu Kelie Para'. Weight: ♂ 29 gr. Wing 90.

PICIDAE

Picumnus innominatus malayorum Hartert: Speckled Piculet.

We found the Speckled Piculet in the scrub oaks and light secondary growth along the trail in the eastern hills from 3,500-4,000 ft. Wing, ♂ 54, 56.5, ♀ 59 mm. Soft parts: iris brown, ocular skin purplish-blue, bill black base of lower mandible gray, feet bluish-gray. Weight: ♂ (2) 11 gr., ♀ 12 gr.

Sasia ochracea reichenowi Hesse: Burmese Rufous Piculet.

A pair were taken at Phek in a thick bamboo clump near the village at 4,800 ft. These belong to the Burmese race of which *querulivox* is a synonym. Weight: (2) 10 gr.

Micropternus brachyurus phaioceps (Blyth): Northern Rufous Woodpecker.

Found in deciduous secondary scrub forest at altitudes from 1,500-4,000 ft. Weight: ♂ 105, ♀ 92 gr.

Picoïdes darjellensis fumidus (Ripley)[1]: Southern Assam Pied Woodpecker.

This is a dark saturated population of the Pied Woodpecker found along the Himalayas in the eastern ranges, and in north Burma. We found these birds only in heavy evergreen forest at 7,000-8,000 ft. My three specimens are somewhat smaller than *darjellensis* from east Nepal and Sikkim, although Burmese birds are equally small. But the dark smoky underparts and darker, more richly-coloured vent patch and nuchal collar, separate this form from its relative to the north and east.

Measurements (mm.):

	Wing	Tail	Culmen
♂ (type)	126.5	83.5	32
2 ♀♀	123, 126	76 (2)	31,32

Weight: ♂ 71, ♀ 61, 63 gr.

Picoïdes cathpharius pyrrhothorax (Hume): Redbreasted Pied Woodpecker.

A single male with a wing measurement of 95.5 mm. is my only record of this rare form. It was taken by a Naga at 4,700 ft. in scrub jungle near Phesama, a village 6 miles south of Kohima.

Picoïdes hyperythrus hyperythrus (Vigors): Rufousbellied Woodpecker.

The two females from Mt. Zephu weighed 37, 41 gr. These birds were taken from 7,000-7,500 ft. in thick evergreen. They have a characteristic rattling call, reminiscent of the genus as a whole. In these specimens the lores seem somewhat more spotted and the tips of the third outermost rectrices more stained with orange-brown (tobacco juice color), than in comparable specimens from the Himalayas. There is no size difference, nor are other more striking characters discernible.

Picoïdes macei macei (Vieillot): Fulvousbreasted Pied Woodpecker.

Specimens were taken at Chakabama 13 miles east of Kohima at 3,000 ft. Males weighed from 43-48 gr., and females from 38-44 gr. The birds were in light deciduous scrub near cultivation. In fact from suitable altitudes of 1,500-3,000 ft., this bird in Manipur and the Naga Hills can be a bird of cultivated areas in hedgerows and occasional high trees about houses. Hume (1888) refers to this species and says that his Manipur birds are more streaked below than typical *macei*, and this statement is referred to by Ticehurst (1939) as a reason for combining the species *macei* and *atratus*. I cannot agree that *macei* from Manipur are significantly larger or more streaked, and with the present very uncertain evidence about the occurrence of the two forms in east Manipur, I am inclined to keep *macei* and *atratus* as separate species.

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[1] Delaçour (*Auk*, **68**, 1951, p. 50), points out that *Picoïdes* Lacépède should replace *Dendrocopos* Koch.

Picoïdes canicapillus canicapillus (Blyth): Burmese Pigmy Woodpecker.

A pair was collected in scrub oaks at 3,000 ft. in the eastern hills. They seem to be pure *canicapillus*. The female has spotted central rectrices, the male unspotted. Wing ♂ 91, ♀ 94 mm. Weight, (2) 24 gr. Soft parts: iris ♂ white, ♀ gray; bill ♂ dark grayish-horn, ♀ grayish-horn; feet ♂ blackish-green, ♀ blackish gray-green.

Blythipicus pyrrhotis pyrrhotis (Hodgson): Banded Bay Woodpecker.

A female from Phesama weighed 140 gr. and had a wing measurement of 142.5 mm.

EURYLAIMIDAE

Psarisomus dalhousiae dalhousiae (Jameson): Longtailed Broadbill.

This seems to be a fairly common bird around Kohima and little boys offered us several for sale at fanciful prices that had been trapped with bird lime. A female shot near Phek weighed 67 gr.

Serilophus lunatus rubropygius (Hodgson): Hodgson's Broadbill.

Two females taken at Phek in thick scrub weighed 33, 35 gr.

HIRUNDINIDAE

Hirundo striolata substriolata Hume: Striated Swallow.

A female from east of Kohima taken while dipping over a stream at about 2,000 ft. seems to belong to this race, *vide* Mayr (1941). It has a wing of 120, tail 83 mm. and lacks a thigh patch. Weight 22 gr.

MOTACILLIDAE

Motacilla alba alboides Hodgson: Hodgson's Pied Wagtail.

The commonest of the many migrant wagtails skittering about the main roads running through the Naga Hills. Two males weighed 23, 25 gr.

The Yellow-headed Wagtail (*citreola*) was also observed in marshy places but collected only in Manipur.

Anthus hodgsoni hodgsoni Richmond: Hodgson's Tree-pipit.

A single bird was taken at 7,500 ft. on Mt. Zephu in an open scrub area near Zephu village. Weight 20 gr.

Anthus hodgsoni yunnanensis Uchida and Kuroda: Northern Tree-pipit.

Taken from 4,700-7,000 ft.; three specimens weighed from 21-22 gr.

CAMPEPHAGIDAE

Pericrocotus flammeus elegans (McClelland): Scarlet Minivet.

The races of this species have been monographed by Deignan (1946). I hope that authors will agree with my suggestion (1948) that the type locality of this form should be re-restricted to Shillong in the Khasia Hills. Specimens of this variable form collected by us in the Naga Hills agree with Deignan's diagnosis in size (wing ♂♂ 97-99, ♀ 98.5 mm.), but show a variation from narrowly to broadly margined with red on the outer web of the central rectrices, and in the case of the single female obtained, a small spot of colour has appeared on the outer web of the third primary. Males weighed from 28-30 gr. and the female 29 gr. The birds were in small flocks in open deciduous forest from 2,000-4,700 ft.

Pericrocotus brevirostris (Vigors): Shortbilled Minivet.

Shortbilled Minivets were collected at different altitudes from 2,500-4,500 ft. in open deciduous forest, and along the edges of evergreen patches. Two pairs having wing measurements of, ♂ 87.5, 88, ♀ 88.5, 89.5 mm. These birds all lack a coloured margin along the outer edges of the inner secondaries and have reduced black areas or yellow tips on the second innermost pair of tail feathers, agreeing with Mayr's admirable diagnosis of these sibling species (1940). Males and females vary from 16 to 17.5 gr.

Pericrocotus ethologus mariae n. subsp.

Type.—No. 12,685, Yale Peabody Museum, ♀ adult, Phek, eastern Naga Hills, Assam, December 6, 1950; S. Dillon Ripley, collector.

Compared to *laetus* Mayr, the adult female is deeper and more pure gray on the upper parts lacking the olive-green wash, the rump and upper tail coverts somewhat richer, more orange-yellow. Below there is a rich, strong orange-yellow wash particularly on the lower throat, but on the upper throat as well, breast, and abdomen. The adult male is, if anything, slightly deeper red than in *laetus*. This a smaller form also.

Compared to *ethologus*, this race is altogether smaller and far more richly coloured in the female, the back gray rather than greenish. Compared to *cryptus* Mayr, these females have a richer orange-yellow suffusion below, reaching the cheeks in one specimen. In addition they have a broader band of orange rather than yellow on the forehead. The male of *mariae* also is more richly scarlet, less orange-red than males of *cryptus*. Compared to *annamensis* these females are less golden below, more orange-yellow. Above they are paler, both in the gray tone of the back and in the orange-yellow of the rump. In fact in tone of colour, *mariae* seems almost exactly intermediate between *cryptus* of east Burma and Siam, and *annamensis* of Indo-

China. This is particularly interesting in view of the decided separation between *mariae* and the two eastern subspecies.

Measurements (mm.):	Wing	Tail	Red on tail	Wing-tail ratio
♂	88	100	28.5 (spot present)	113%
2 ♀♀	85, 86.5	99.5, 104		117, 120% [1]

Much to my surprise the three specimens of *Pericroctus ethologus* collected by my wife and myself in the Naga Hills and the hills of northern Manipur adjacent to the Naga Hills (Kangpokpi), when compared with *laetus* proved to be far more richly coloured than that form whose distribution as given by Mayr (loc. cit.) is 'Sikkim, Bengal, Cachar, and Assam'. It gives me great pleasure to name this new form for my wife.

Range: Naga Hills in Assam and northern Manipur.

Pericrocotus solaris solaris Blyth: Graythroated Minivet.

A pair were taken in the eastern Naga Hills at 6,000 and 8,200 ft. in evergreen forest. Both specimens weighed 15 gr.

Pericrocotus roseus roseus (Vieillot): Roseate Minivet.

A wanderer at this season, found by us at 3,500 ft. in the lower hills. Weight 16 gr.

Hemipus picatus capitalis (McClelland): Brownbacked Shrike.

Found from 2,000-5,000 ft., in light scrub or open deciduous forest in small flocks in the tops of small trees. Their tit-like insistant 'chip' calls immediately attract attention. Males and females weigh from 8.5-9.5 gr.

Tephrodornis gularis pelvica (Hodgson): Wood-shrike.

A female taken in open deciduous scrub at 3,500 ft. on the Meluri road weighed 46 gr.

Coracina fimbriata melaschista (Hodgson): Dark Gray Cuckoo-shrike.

A male taken at 2,500 ft. among a flock of minivets in a large open tree near the Tizu River weighed 41 gr.

AEGITHINIDAE

Chloropsis hardwickii hardwickii Jardine & Selby: Orangebellied Chloropsis.

A common bird from 4,000 to over 8,000 ft. primarily in light fig and other open trees of secondary scrub or remaining deciduous forest. A prominent member of the hunting party associations. Some males were in subadult dress, November and December. Weights ranged from—♂♂ 32-40, ♀♀ 25-34 gr.

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[1] Mayr (loc. cit.) gives a wing-tail ratio for *cryptus* of 104.4-114%.

PYCNONOTIDAE

Spizixos canifrons Blyth: Finchbilled Bulbul.

The Finchbilled Bulbul is not uncommon but shy, and although we saw it numerous times from Kohima at 4,700 ft. up into the higher hills, one or more of the birds always seemed to be just dashing over onto the other side of some thick bushes in the open scrub pastures where it mostly lives, and we could never quite collect a specimen. I did, however, shoot one out of a tall tree in thick evergreen on the slopes of Mt. Zephu at 6,800 ft. Weight 44 gr. Wing 102.5 mm.

Pycnonotus flaviventris flaviventris (Tickell): Blackcrested Yellow Bulbul.

A bird of open scrub and secondary growth from 3,500-5,000 ft. I was much surprised one day when sitting on the summit of Mt. Zephu to see a group of these birds working through an open scar in the jungle where evidently lightning or a small forest fire had burned off some of the original heavy evergreen forest. As I watched the flock moved on up and over the crest of the mountain, flying high over the jungle. Two males weighed 30, 34 gr.

Pycnonotus jocosus monticola (McClelland): Redwhiskered Bulbul.

The races of this species (*Otocompsa emeria* of the Fauna) have recently been revised by Deignan (1948). The darker form of Sikkim, Bhutan, and Assam, and farther east must now be known as *monticola.* Two females of this common bird of open scrub country near villages, were collected at 3,500 and 3,750 ft. They weighed 34, 36 gr.

Pycnonotus cafer stanfordi Deignan: Burmese Redvented Bulbul.

The common Redvented Bulbul of the Naga Hills about Kohima appears to belong to the northern Burmese race as defined by Deignan (1949) in a revision of this species. Presumably *stanfordi* ranges from the Naga Hills north along the Patkoi Range and south through Manipur to the Chin Hills. A male from Kohima weighed 47 gr.

Pycnonotus striatus arctus Ripley: Eastern Striated Green Bulbul.

Striated Green Bulbuls from the Naga Hills are dark with the blackish edgings to the feathers of the crest and shading on the tail and breast which prompted me to describe *arctus* from the Mishmi Hills. They are similar in size to Nepal birds, however. Four males and a female measure—wing ♂ 105-111, ♀ 105 mm.; culmen ♂ 18-19.5, ♀ 18 mm.

We found these birds in evergreen or on the edges of evergreen forest from 5,200-8,200 feet. Weight: ♂ 52-58, ♀ 53 gr.

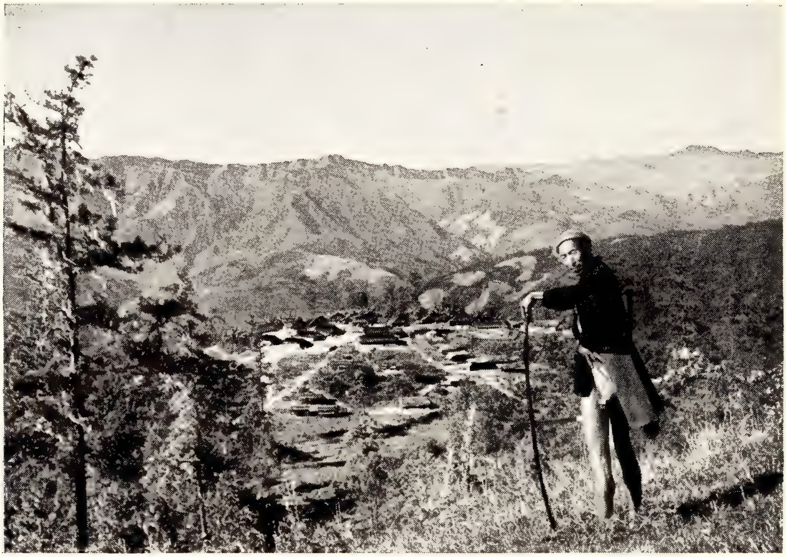
Pycnonotus flavescens flavescens Blyth: Blyth's Bulbul.

Males and females were collected from 3,750-4,000 ft. We found this bulbul in small groups in thick bushes in pasture or cut-over scrub near villages. When alarmed they have a harsh churring note like a laughing thrush. But they also possess a sweet pycnonotine

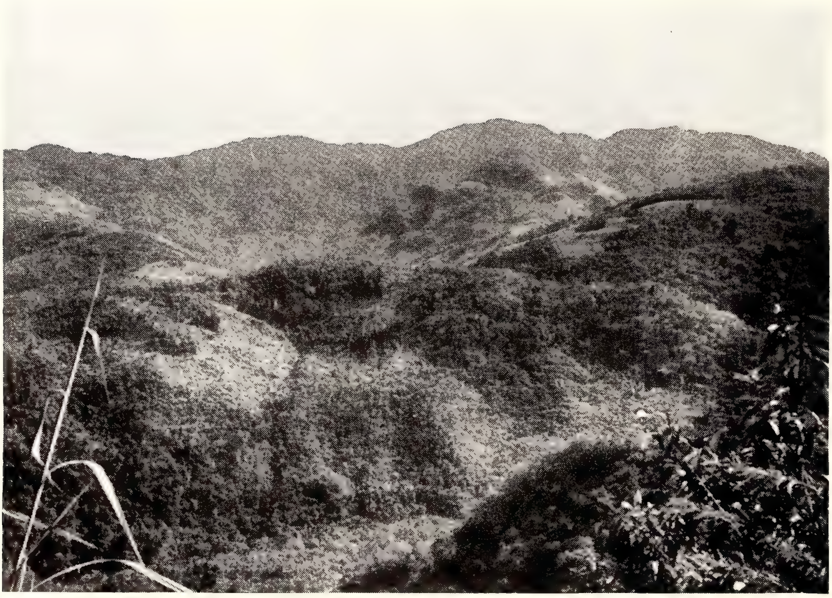
View on Mt. Japvo (7,700 ft.) showing the shrubby undergrowth where we found *Pnoepyga, Spelaeornis,* and *Tesia* as well as *Garrulax austeni.*

Photos *Author*

Summit of Mt. Japvo (9,890 ft.).



Upper Phozami village from the lower slopes of Mt. Zephu. Note crossbow, still used for bird hunting.



Photos *Author*

Mt. Zephu (8,400 ft.) in Sangtam Naga country. This mountain is a northward extension of ridge of Mt. Mol Lan on Burma border, and lies perhaps six miles west of the estimated border itself.

song of two bold notes followed by a short trilling run. They are alert and somewhat shy and will not tolerate too close an approach.

Microscelis flavala flavala (Hodgson): Browneared Bulbul.

The Browneared Bulbul was fairly common around cultivated areas as was the preceding species, from 2,500-4,700 ft. Weight: ♂ 29-38, ♀ 29 gr.

Microscelis madagascariensis nigrescens (Baker): Assam Black Bulbul.

A common noisy species, found from low-lying areas up to 8,000 ft. or more, wandering erratically in flocks throughout the winter months. We found considerable variation in weight in these birds, in apparent adults from 53-64 gr.

Microscelis mcclellandi mcclellandi (Horsfield): Rufousbellied Bulbul.

Found in light deciduous forest from 3,000-8,200 ft., sometimes associated in mixed hunting parties. Weight 42-48 gr.

CINCLIDAE

Cinculus pallasii, the Brown Dipper, was seen along the Tizu River at 2,500 ft., but not collected.

MUSCICAPIDAE

Subfamily TURDINAE

Erithacus calliope calliope (Pallas): Rubythroat.

A male of this migrant was taken at Phek. Weight 23 gr.

Erithacus chrysaeus chrysaeus (Hodgson): Golden Bush-robin.

On Mt. Japvo at 9,250 ft., November 7, a loud wren-like 'chick' noise in low ferns and strobilanthes near the ground in evergreen forest, prompted me to stalk and collect a single specimen of the Bush-robin, the only one we found, and possibly a migrant from the hills north of the Brahmaputra. It appeared to be a young male, but is in female plumage. Weight 14 gr.

Erithacus indicus indicus (Vieillot): Whitebrowed Bush-robin.

A single bird was taken in a thicket at 8,200 ft. on Mt. Japvo. Weight 14.5 gr.

Erithacus cyanurus rufilatus (Hodgson): Redflanked Bush-robin.

Common on Mts. Zephu and Japvo in the evergreen under-story. Five females weighed from 12-14 gr., a single adult male 14 gr., and a subadult male just beginning to assume some of the blue adult plumage, 15.5 gr.

Phoenicurus hodgsoni (Horsfield & Moore): Hodgson's Redstart.

A female was taken along the Meluri trail in scrub pasture. Weight 18.5 gr.

Phoenicurus frontalis frontalis Vigors: Bluefronted Redstart.

Wintering birds were collected from 4,800-9,890 ft. in open pasture and scrub land. Weight: ♂ 15, ♀ (3) 17 gr.

Myiomela leucura leucura (Hodgson): Whitetailed Blue Robin.

A female was taken in thick scrub jungle at Phek, 4,900 ft. Weight 26 gr.

Enicurus maculatus guttatus Gould: Eastern Spotted Forktail.

The Spotted was the only forktail encountered by us. A male was shot on the Meluri trail at 2,500 ft. in a damp spot in heavy evergreen jungle. It had a loud harsh alarm note 'tseek,' rather like a Whistling Thrush. Weight 39 gr.

Saxicola torquata przewalskii (Pleske): Turkestan Bush-chat.

Not uncommon in patches of pasture land up to nearly 5,000 ft. Weight 14.5-16 gr.

Saxicola torquata stejnegeri (Parrot): Japanese Bush-chat.

In similar localities to the above. Slightly paler and with a stouter bill. Weight ♂ subadult 14.5 gr.

Saxicola ferrea Gray: Dark Gray Bush-chat.

Common in pasture land from 4,900-6,000 ft. Three males weighed 15.5-16 gr., a female 15 gr.

Monticola rufiventris (Jardine & Selby): Rufousbellied Rock-thrush.

This rock-thrush was the only one we found in the Naga Hills. It seemed to prefer clearing edges from 4,000 to 7,000 ft. A pair were active in very high pines at Meluri in the evening, flying from tree to tree making a harsh rasping indrawn rattle 'ahhhrrr,' interspersed occasionally with a high shrill 'tick,' the two sounds spaced far apart, unrelated. The birds perched facing along the big branches rather than crosswise, and carried their tails high and cocked. Weight: ♂ 56, 59; ♀ 48, 56 gr.

Zoothera dixoni (Seebohm): Longtailed Plainbacked Mountain Thrush.

Three of these shy thrushes were collected by us above 7,700 ft., in evergreen forest on Japvo and Zephu. They fly up from a trail quite silently to a perch in a tree and sit very still hoping to be unobserved. The colour of the feet of this species varied from 'flesh' to 'dull yellow'. Wing: ♂ 139, 148.5, ♀ 135 mm. Weight: ♂ 98, 103, ♀ 97 gr. One male had enlarged gonads in mid-November.

Zoothera dauma dauma (Latham): Smallbilled Mountain Thrush.

A bird of the year, a male, taken on Mt. Zephu at 8,200 ft. weighed 130 gr.

Turdus dissimilis Blyth: Blackbreasted Thrush.

A male in subadult plumage from Phek weighed 75 gr.

Turdus obscurus Gmelin: Dark Thrush.

Nine males and eight females of this common migrant were taken by us from 2,500 ft. up. Males weighed from 65 to 80, and females from 59 to 75 gr.

Subfamily TIMALIINAE

Pellorneum ruficeps chamelum Deignan: Cachar Spotted Babbler.

A trio of this subspecies described by Deignan (1947) from Cachar prove that this form extends west-east from the Garo Hills to the eastern Naga Hills east of Kohima. These birds from Phek and the trail farther east were shot in thick scrub jungle at 4,800 ft. and differ slightly in the colour of the bill; ♂ 'upper mandible black, lower basally yellow, distally gray, ♀ upper mandible basally black, distally grayish-horn, lower basally yellow, distally gray. They weighed: ♂ 31, ♀ 26.5-28 gr.

Pellorneum albiventre nagaensis (Godwin-Austen): Naga Brown Babbler.

Two males from Phek and Meluri were taken in very heavy cut-over scrub, wood-lot areas near villages. They measure—wing 58.5, 59; tail 59, 57 mm.; wing-tail index 96, 100.5%. Weight 21, 22 gr.

Pomatorhinus ruficollis bakeri Harington: Baker's Rufousnecked Scimitar Babbler.

Adults and one subadult (late October) were taken from 4,700-6,000 ft. These scimitar babblers like to work through heaps of fallen vegetation, thickets in scrub pasture and brush piles, calling occasionally, a harsh rattling grating call that sounds rather like *Pomatorhinus erythrogenys*, the Rustycheeked Scimitar Babbler. Sometimes they make a grating mewing sound, rather like what one fancies a small bird would utter caught in the talons of a hawk. Two adult males weighed 31, 32, an adult female 29, and a subadult female 27 gr.

Pomatorhinus erythrogenys mcclellandi Godwin-Austen: McClelland's Scimitar Babbler.

A noisy babbler found by us in thick scrub under 5,000 ft. Males weighed 57, 58, and females 47, 54 gr. Soft parts: iris yellowish-cream, creamy white; bill upper mandible blackish or dark brown basally, distally grayish-brown, lower grayish or whitish brown, base of lower mandible yellow; feet brown to grayish brown; ocular skin dark purplish-blue.

Pomatorhinus ochraceiceps austeni Hume: Hume's Scimitar Babbler.

A single female taken on the trail to Yisi at 2,000 ft. on a steep slope in mixed deciduous-evergreen forest is our only specimen of this little-known form. Soft parts: iris dull pinkish-cream; bill orange coral; feet dull greenish brown. Weight 34 gr.

Pnoepyga albiventer albiventer (Hodgson): Scalybreasted Wren Babbler.

In the solid ground cover of ferns, strobilanthes and nettles that grew waist-high on Mt. Japvo under the evergreen forest canopy at 7,000 to 9,000 ft., Wren Babblers and Wren Warblers were numerous. The Scalybreasted Wren Babbler was apparently fairly common although its quiet skulking habits made it difficult indeed to see. It has a single alarm note, an explosive 'chick,' uttered sometimes within a foot or two of the quiet stalker. Three males weighed from 21-23, a presumed female (fulvous below and sexed as a male ?), 22 gr.

Pnoepyga pusilla pusilla Hodgson: Brown Wren Babbler.

The Brown Wren Babbler seems to occur from 3,500 ft. up in the Naga Hills. We took it at all altitudes in similar biotope to the preceding species. Except for the difference in size, the two species seem identical in habits and requirements, although presumably they replace each other to some extent altitudinally, *albiventer* living higher up but with a wide margin of overlap. The only call I heard, the alarm note 'chick,' seemed similar to the other species.

Weight: ♂ 11, 12, ♀ 11 gr.

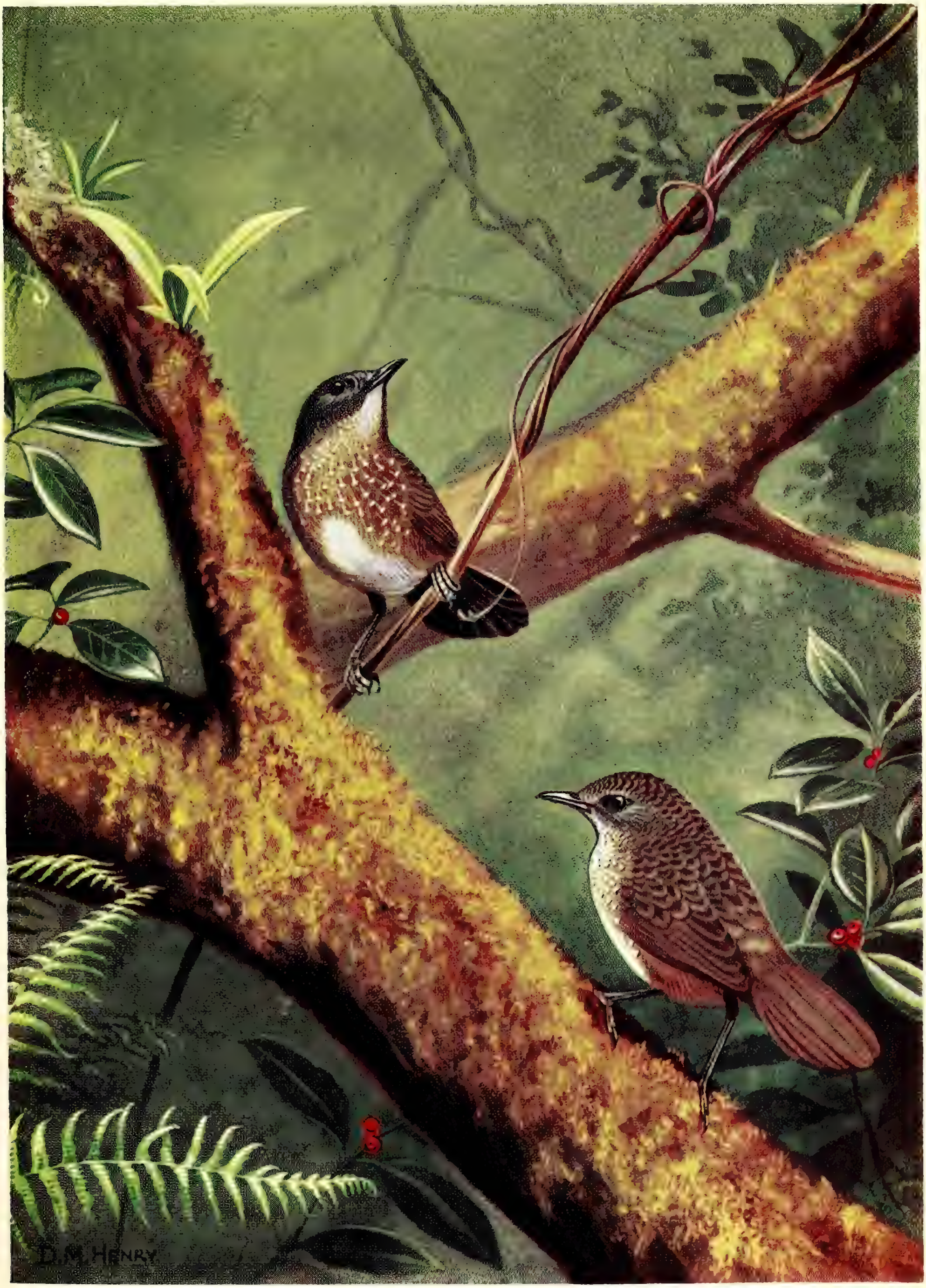
Spelaeornis chocolatinus nagaensis Ripley: Naga Wren Babbler.

These delicate little Wren Babblers were very common on the slopes of Mt. Japvo above 7,000 ft., feeding evidently among one of the low strobilanthes which was in flower and had attracted many insects. The only call I could with certainty ascribe to this species was a low chuckling warning note. However, I heard several times a very loud explosive, melodic whistle 'wheeeuw,' and once in the gloaming saw a tiny wren-like figure scuttling over the moss-covered rocks where the call had just come from. From the fact that it seemed to have a tail I presumed that it was this Wren Babbler. As I pointed out in my original description (1951) there seems to be sexual dimorphism in this form, females being much more rufescent on the underparts than males, in this character perhaps resembling *chocolatinus chocolatinus*. The two specimens of the latter which I have seen in the British Museum are very rufescent. As both specimens are unsexed, they may perhaps both be females?

Weight: ♂ 10.5-14.5, ♀ 14 gr.

Measurements: wing 48-52.5, tail 41-44, culmen 12.5-14 mm.

When I reviewed this genus (1950), I unfortunately overlooked an important note by Ticehurst (1939) on the identity of *Elachura haplonota*. This species was listed by Delacour (1947) in his revision of the babblers as a member of the genus, *Spelaeornis*, as he too had apparently missed Ticehurst's note. Ticehurst (loc. cit.), having compared the unique specimen of *haplonota* from North Cachar with a specimen of *Spelaeornis chocolatinus* from the 'Naga Hills' in the British Museum collected by Godwin-Austen, declared that the two represented the same species, the type of *haplonota* differing only by being fulvous-white on the throat, and less rufescent on the breast and sides of the body.



Spelæornis chocolatinus nagaensis Ripley.

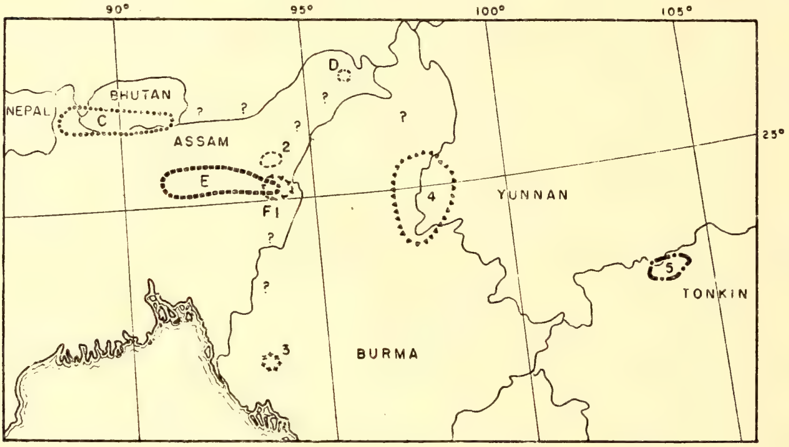
Thus the difficult situation with respect to listing the species of this obscure genus becomes more pronounced. In my original review of *Spelaeornis* (loc. cit.), I listed the following species: (*a*) *formosus*, from the hills north of the Brahmapûtra, and Fukien; (*b*) *haplonotus*, known from a single specimen from north Cachar; (*c*) *troglodytoides*, a well-marked species with several subspecies from north-eastern Bhutan, north and east into Kansu and Shensi, west China; (*d*) *caudatus*, known from the hills north of the Brahmaputra; (*e*) *badeigularis*, known from a single specimen from the Mishmi Hills; (*f*) *longicaudatus*, from the Khasia Hills south of the Brahmaputra east to north Cachar and south to Kedimai, Manipur, a locality from which a single specimen exists which I have examined, and (*g*) *chocolatinus*, a species with several subspecies ranging from Manipur south to the Chin Hills and north-east into the Shan States, Yunnan, and, somewhat isolated, one population in north Tonkin. To this last species I have now added the subspecies *nagaensis* from the Naga Hills north of Manipur, which differs from typical *chocolatinus* by being much more olivaceous-brown, less rufous above, and with distinctly grayish-brown rather than rufous-brown lores, cheeks and sides of the head. The underparts also are far less rufous.

The situation is now complicated by the fact that *haplonotus* is shown to be a synonym of *chocolatinus*. This eliminates one of the species from my list, and further demonstrates that the two species, *longicaudatus* and *chocolatinus*, have overlapping ranges in north Cachar, and the western side of the northern Manipur Hills. This extends the range of *chocolatinus* west for 40 miles in an airline into the range of *longicaudatus*.

In addition the specimen of *chocolatinus* in the British Museum from the 'Naga Hills' poses another problem. This specimen was unfortunately not seen by me during my visit to London, but it seems inconceivable that two forms as close in size and general pattern as *chocolatinus* and *nagaensis* can coexist in the Naga Hills. I prefer to think that the political boundaries of the area in the 1870's when the collection of Godwin-Austen was made account for the slip, as there is no more detailed locality on the label than: 'Naga Hills—Date-winter. Cat. No. 482.'

Sir Norman Kinnear has said that the records of collections from which this may have come, those made by Ogle and Chennell in the winter of 1875-76, are untraceable. I presume, therefore, until further evidence is forthcoming that the 'Naga Hills' referred to on the label of this specimen of *chocolatinus* are on the Manipur side where there are many Naga tribes, and that *chocolatinus chocolatinus* occurs in what is now known politically as Manipur, and west into north Cachar (Hangrum, type locality of *haplonotus*, a village some 17 miles east of Haflong), while *chocolatinus nagaensis* occurs in the Naga Hills proper in the Kohima area, from the Barail Range (Mt. Japvo) on the west, east to Pfutsero at least.

More recently M. Delacour (1951) in a discussion of the birds of Indo-China, has referred to my revision of *Spelaeornis* and cast doubt on the question of the distinctness of the species enumerated by me. He would prefer to list them all as subspecies of each other, presuming that they replace each other geographically, and are otherwise closely related. Unfortunately he overlooked the fact that I had examined the specimens concerned and had found that in one case two of the forms were sympatric. Until more is known of the distribution of these elusive and perplexing birds, I would still prefer, therefore, to take the less conservative view and list the following closely related species illustrated on the map. (I exclude species (*a*) *formosus*, and (*b*) *troglodytoides*, which are distinct enough not to enter into the discussion.)



The species of my list then are (*c*) *caudatus* (range farther east unknown), (*d*) *badeigularis* (range, except in one area of the Mishmi Hills, unknown), (*e*) *longicaudatus* (partially sympatric with the next), (*f*) *chocolatinus* with five subspecies, the ranges of which are still not worked out; (1) *chocolatinus*, (2) *nagaensis*, (3) *oatesi*, (4) *reptatus*, (5) *kinneari*.

Stachyris ruficeps ruficeps (Blyth): Redheaded Babbler.

A few specimens of this rather shy little babbler were collected from 4,900-7,700 ft. in heavy evergreen forest or cut-over scrub, but always the birds were in dense undergrowth. Soft parts: iris red; bill upper mandible blackish or brownish-horn, lower basally purple, distally gray, or, pearly horn to pinkish horn; feet variously brownish green, brownish yellow, greenish brown or yellowish gray! In fact there seemed to be just such variation in the colour of the feet. Weight: ♂♂ 10-12, ♀ 9.5 gr.

Stachyris chrysaea chrysaea Blyth: Goldenheaded Babbler.

Three males taken from 4,000-7,000 ft. are our only record of this species. Weight 8.5-10 gr.

Stachyris nigriceps coltarti Harington: Blackthroated Babbler.

Three males of this species were taken in thick scrub jungle from 4,800-4,900 ft. Weight 16-17 gr.

Timalia pileata bengalensis Godwin-Austen: Redcapped Babbler.

A male and female from 2,500 and 4,500 ft. taken in open pasture scrub weighed: ♂ 17, ♀ 15 gr.

Paradoxornis poliotis poliotis (Blyth): Blyth's Suthora.

A series of these tiny buzzing creatures was taken on Mt. Zephu at over 8,000 ft. A few others were taken near Phek at over 6,000 ft. They were as always difficult to see and collect, streaming through the low bamboos under the heavy evergreen overstory, in large flocks, continually in motion. Weight 5-6.5 gr.

Paradoxornis ruficeps bakeri (Hartert): Baker's Parrot-bill.

A relatively common bird along the trail east of Phek from 2,500 to just under 4,000 ft. These rather slow-moving and unsuspicious parrot-bills frequented the pastures and edges of bamboo scrub, feeding on ripening weed seeds, some cultivated millet, and insects. Their call is very characteristic, a squirrel-like chitter interrupted with a series of rather slowly pronounced double notes, 'tee-ur'. Soft parts: iris brown, reddish-brown; ocular skin blue; bill upper mandible dark brownish or blackish horn, lower mandible and tomia grayish horn; feet bluish-gray. Weight: ♂♂ 35-38, ♀ 33, 35 (♀?) 40 gr.

Measurements: wing ♂♂ 86-90.5, ♀ 84.5 (2), (♀?) 90 mm. These birds seem slightly smaller than the measurements given by Baker (1922), but in colour they are mostly similar, although it is worth noting that there is very considerable variation in the shade of colour of the red of the head and the olive-brown of the upperparts.

Paradoxornis flavirostris guttaticollis David: Austen's Parrot-bill.

A single female was shot at 3,500 ft. along the trail near Primi in a millet field. It was one of a flock of four birds associated with *Garrulax ruficollis*. The birds were at least partly feeding on the ripe millet. They made soft 'tee-ur' calls. Iris brown, bill yellow, feet bluish-gray. Weight 26.5 gr. Wing 80 mm.

Garrulax pectoralis uropygialis Bonaparte: Blackgorgetted Laughing-thrush.

This is a variable population as Sálim Ali and I had pointed out in the Mishmi Hills paper (1948). Specimens irrespective of sex have black ear coverts, or black with occasional streaks of white, or nearly all white ear coverts. There is variation also in the amount of rufous shading on the upper- or underparts. Wing: ♂♂ 130, 134; ♀♀ 130-150 mm. Weight ♀ (2) 135 gr.

We met these laughing-thrushes in small flocks near the outskirts of villages in deciduous second growth, occasionally turning over the heavy fall of oak and other leaves on the ground. When disturbed they would fly off in low dipping flights and work away from the hunter skilfully putting trees between themselves and him.

They had harsh churring conversational calls back and forth within the flock.

Garrulax leucolophus patkaicus Reichenow: Whiteheaded Laughing-thrush.

The Whiteheaded Laughing-thrush was an easily noted bird from 2,500 to nearly 5,000 ft. Males and females weighed from 104-130 gr. They frequented deciduous scrub, usually near villages. Moulting specimens were taken into late November. This name antedates *hardwickii* Ticehurst.

Garrulax galbanus Godwin-Austen: Austen's Laughing-thrush.

This striking looking laughing-thrush with a black face and chin and yellow underparts, was taken by us along the Meluri trail at 3,000 ft. as well as in Manipur. It provides the first record for the species in the Naga Hills. The birds were in tall grass and cut-over scrub. Soft parts: iris pinkish brown, reddish brown; ocular skin blue; bill black; feet blackish gray. Weight: ♂ 56, 57, ♀ 55 gr.

Garrulax gularis gularis (McClelland): McClelland's Laughing-thrush.

I came on a small flock of this most inconspicuous species, busily scratching in the leaves in a most impenetrable tangle of undergrowth near the trail beyond Meluri at 3,000 ft. They made occasional low harsh typical laughing-thrush churring noises, indistinguishable to me from those of others of the genus. I was able to obtain one male before the flock characteristically vanished. Soft parts: iris reddish brown; bill black; feet yellowish orange. Weight: 92 gr.

The resemblance between this form and *delesserti* is most striking. Proportions, size, and colour pattern are all similar. The south Indian bird has had all the yellow and olive tones washed right out of the plumage as if in life it were simply badly faded and foxed.

Garrulax cineraceous cineraceous (Godwin-Austen): Ashy Laughing-thrush.

The Ashy Laughing-thrush was found near villages in thick scrub from 4,200 ft. up to 5,000 ft. It is a shy skulker like all the others although once I came on a party on a village path busily turning over heaps of buffalo dung evidently looking for insects.

Soft parts: iris varied from creamy yellow to pinkish cream; bill, upper mandible brownish horn, lower, yellowish or whitish horn; feet pale brownish flesh. Weight: 47-51 gr.

Garrulax rufogularis assamensis (Hartert): Rufouschinned Laughing-thrush.

This laughing-thrush was taken in exactly the same biotope as the preceding species, but to us seemed less common. We obtained only a pair, at 4,300 and 4,900 ft. near villages in thick cut-over scrub. Wing: ♂ 94.5, ♀ 92 mm. The female lacks a complete black cap and is more rufescent below, and so is presumably sub-adult. Weight: ♂ 67, ♀ 64 gr. This subspecies is a somewhat more saturated form than the typical one, but seems not to be smaller as described by Hartert (1909).

Garrulax caerulatus livingstoni n. subsp.

Type.—No. 12,961, Yale Peabody Museum, ♂ adult, Mt. Japvo, Naga Hills, Assam, November 6, 1950; S. Dillon Ripley, collector.

This specimen has been kindly compared with the type and one other specimen of *subcaerulatus* from the Khasia Hills in the British Museum Collection by Mr. J. D. Macdonald, who has written me about the matter. Compared to that form it lacks the whitish ear coverts, tipped with black, the paler upperparts, and the broad white tipping of the three outermost pairs of tail feathers.

Compared to *caerulatus*, this form has the forehead more distinctly blackish, the feathers of the crown rufous-brown, darker than in the nominate form and more broadly edged with black, and the upper parts richer, more saturated with rufous. Mr. Macdonald concludes of this form (in litt.), 'I would say that it is quite clearly distinct from both races, but probably more closely allied to the nominate race'. As specimens of *subcaerulatus* were lacking in this country, and I could not match my bird with *caerulatus,* I am most grateful to Mr. Macdonald for confirming my feeling that this specimen could hardly represent *subcaerulatus* as described (Baker, 1922, p.142.) Compared with *kaurensis* this form has the ear coverts white tipped with blackish-rufous.

Two birds were collected on Mt. Japvo at 7,700 ft. but unfortunately one was too badly damaged to be saved and the species was not seen again. Soft parts: iris brown; ocular skin dark blue; bill black; feet pale bluish-white. Weight 98 gr. Wing 118; tail 125, culmen 24. Range: known only from Mt. Japvo, Naga Hills.

This subspecies is named for my late friend and father-in-law, the noted sportsman, Gerald M. Livingston.

Soft parts: iris brown; ocular skin dark blue; bill black; feet pale bluish-white. Weight: 98 gr.

Garrulax ruficollis (Jardine & Selby): Rufousnecked Laughing-thrush.

This is a lower altitude species than the Ashy or the Rufous-chinned, but may be seen in the same habitat from 2,500 ft. up to nearly 5,000 ft. on occasion. We found them once in a millet field when the seed was ripe, otherwise in hedgerows and scrub pasture working through the thickets with constant churring calls among the flock. They also utter a three-noted mellow whistle the first note of which is reedy, as if the reed were broken. Weight: 60-67 gr.

Garrulax sannio albo-superciliaris Godwin-Austen: Whitebrowed Laughing-thrush.

Another species of pasture and cut-over scrub land, frequenting thick bushes between 3,500 and 5,000 ft. Two males weighed 68, a female 56 gr. Deignan (in litt.) distinguishes several forms of this species, of which this one has a continuous white supercilium and brown ear coverts.

Garrulax austeni austeni (Godwin-Austen): Cachar Laughing-thrush.

We found this dark brown inconspicuous laughing-thrush only in the evergreen forest on Japvo from 7,700 to 8,850 ft. It frequented dense tangles of brush where large forest trees had fallen, or the thicker undergrowth under the main canopy. A male taken in thick brush with a small flock of the species was calling on November 11th, in a very reminiscent way to that of the Spotted Babbler (*Pellorneum ruficeps*), a liquid three-note whistle, 'to meet you' as that call has been rendered, but much louder. The flock also called back and forth with loud harsh calls like a wounded tree-pie. At other times when working in the underbrush they would make a soft 'tick' like wren. Four males have wings from 90-100, a female 90 mm. Soft parts: iris brown—once, pale whitish-brown, once clay brown; bill black; feet brown. Weight: ♂♂ 63-74, ♀ 59 gr.

Garrulax erythrocephalum godwini (Harington): Redheaded Laughing-thrush.

The commonest laughing-thrush of high evergreen forest, found by us from 5,250-9,200 ft. Travelling in flocks they exchange a constant series of low twitters and chuckles as they hop and flirt through the low bushes, on the ground, or, occasionally among the gnarled and twisted trunks of stunted oaks and rhododendrons. One male had enlarged gonads in early November, although no females showed similar signs. One female had small intestinal worms. A female was in heavy wing moult November 12th.

Soft parts: iris dark grayish brown, dark brownish gray (5♀♀); bill blackish brown; feet fleshy brown.

Wing: ♂♂ 97-102.5; ♀♀ 93-106.5 mm. Weight: ♂♂ 74-92 gr.

Garrulax phoeniceum bakeri (Hartert): Crimsonwinged Laughing-thrush.

A subadult male was taken below Kohima October 15th, which could not have been long out of the nest. It weighed 48 gr. An adult male taken farther to the east at 6,000 ft. weighed 45 gr.

Leiothrix argentauris vernayi (Mayr & Greenway): Silvereared Mesia.

Synonym: *Leiothrix argentauris gertrudis* Ripley (1948).

Examination of the series collected in the Naga Hills over to the Chindwin River of Burma, and on to the Shan States, northern Thailand, and southern Yunnan shows that they should all be combined under the name *vernayi*. My Naga specimens link *vernayi* and *gertrudis* in measurements (wing ♂♂ 71.5-76 mm.), and I can find no colour differences in the areas enumerated above which seem constant.

These birds were found in mixed deciduous and evergreen jungle from 3,900-4,800 ft. Weight: ♂♂ 24.5-26, ♀♀ 22-24.5 gr.

Cutia nipalensis nipalensis Hodgson: Nepal Cutia.

A male from the evergreen forest on Mt. Zephu belongs to this form. Wing 98 mm. Weight 56 gr.

Pteruthius rufiventer rufiventer Blyth: Rufousbellied Shrike-Babbler.

A silent species found by us in small flocks in the mid-level of trees in evergreen forest on Mts. Japvo and Zephu from 7,700-8,200 ft. One of the birds struck me as looking like Hodgson's Broadbill when I first saw it, both in its superficial appearance, and in its rather lethargic behavior.

Weight: ♂♂ 46-48, ♀♀ 41.5, 44 gr. Soft parts: iris bluish gray; bill upper mandible black, lower pearl gray; feet brown to brownish-whitish.

Pteruthius erythropterus erythropterus (Vigors): Redwinged Shrike-Babbler.

Fairly Common in evergreen forest from 4,800-6,800 ft. Recently Koelz (1951) has described a new race *validirostris* from Kohima differing from *erythropterus* of the Himalayas and the Chin Hills, 'in having a darker gray on back and smaller white tips to the primaries in the males; in having a clearer gray on crown and very distinct postocular stripe in females; and in having a much stouter bill in either sex'. My series of three males and two females do not bear this out. A female from Nepal in our collection has, if anything, a stouter bill than the Naga females. The tendency to a postocular stripe in females seems to be a variable feature appearing or disappearing throughout the range. Again, the bill of the males and the colouration of the back and the size of the terminal white tips is variable, and disappears as a character in a large comparative series. There is no difference in size in the range of the nominate form. It is difficult for me, therefore, to credit this proposed form.

Weight: ♂♂ 36, 38, ♀♀ 37, 38 gr.

Pteruthius melanotis melanotis Hodgson: Chestnutthroated Shrike-Babbler.

Two males and a female were shot between 6,000 and 7,700 ft. in evergreen forest, well up in the trees, moving in mixed flocks of babblers and warblers. Weight: ♂♂ 11.5, 14.5, ♀ 14 gr.

Gampsorhynchus rufulus rufulus Blyth: Whiteheaded Shrike-Babbler.

In contrast to Stanford (1941), I have always seen these birds with scimitar-babblers, both in bamboos, and low near the ground in thick shrubbery. Soft parts: iris yellow; bill dark horn; feet brownish-white. Weight: ♂ 37 gr.

Actinodura egertoni khasiana Godwin-Austen: Shillong Bar-wing Babbler.

Three males and a female of this subspecies were taken in thick shrubbery both in evergreen forest and also in scrub jungle on the edges of pasture and village wood-cuttings from 3,750-7,700 ft. Weight: ♂♂ 38 (3), ♀ 34.5 gr.

Actinodura nipalensis waldeni Godwin-Austen: Walden's Bar-wing Babbler.

The commonest babbler in the evergreen forest on Mt. Japvo (type locality of the subspecies). We found this bird both there and on

Mt. Zephu from 7,700 feet up, high in the trees and low in thick scrub and masses of fallen branches and forest debris. There is considerable colour variation in a big series. Wing: ♂♂ 89.5-97, ♀♀ 86-99 mm. Some birds, both male and female are in semi-breeding condition (testes slightly enlarged or ovaries slightly granular) in November. Weight: ♂♂ (10) 39-56, ♀♀ (8) 41-53 gr.

Siva ignotincta ignotincta (Hodgson): Redtailed Minla.

A bird of evergreen jungle found in the tree tops in mixed parties with other small babblers and warblers, from 5,250-7,700 ft. Males weighed 15-16.5, one female 16 gr.

Siva strigula yunnanensis Rothschild: Stripethroated Siva.

This brightly coloured siva was one of the birds of the evergreen on Mt. Zephu from 7,700 ft. up, working in flocks through the tops of the oaks and rhododendrons. Soft parts: iris reddish brown or brown; bill upper mandible black, lower gray; feet gray.

Three specimens measure; wing ♂ 71, ♀ 66 (2) mm. Weight: ♂ 21, ♀♀ 17, 21 gr.

This form apparently occurs from the Mishmi Hills south through the Patkoi and the east Naga Hills in extreme eastern Assam, and is found farther south to Mt. Victoria.

I was surprised, on comparing my specimens, to discover that the series collected on Mt. Japvo in the Barrail Range of the western Naga Hills belong to an undescribed form which I hereby describe as:

Siva strigula cinereigenae n. subsp.

Type.—No. 12,119, Yale Peabody Museum, ♂ ad., Mt. Japvo, western Naga Hills, Assam, November 4th, 1950; S. Dillon Ripley, coll.

From *yunnanensis* Rothschild (both series are in fresh plumage), this subspecies differs in having a whitish eye-ring and a whitish superciliary. The sides of the cheeks are gray, mottled with whitish and dusky, not olive-yellow, or even orange-tinted as in *yunnanensis*. Below, this form tends to be less bright, less brightly orange-yellow on the chin, less brightly yellow on the chest the sides of which are grayish, and on the abdomen. There is no significant difference in the tone of the upper parts, and the amount of chestnut on the tail is similar.

From *strigula* Hodgson of the Himalayas this subspecies differs in a somewhat darker, more brownish-orange tint to the crown and more olive-brownish upper parts, and in having a greater area of chestnut on the tail. The eye-ring, superciliary and cheeks are grayish rather than suffused with olive-yellowish as in *strigula*. Below, the chin patch is less bright but the tone of the underparts otherwise tends to be purer orange-yellow, less tinged with olive. The western Himalayan *simlaensis* is of course a much paler bird.

In worn specimens of this subspecies, the feathers of the back lose their warm brownish tone and become very gray progressively, starting from the nape.

Measurements (mm.);

	Wing	Tail	Culmen
5 ♂♂	66.5-71.5	64-73	12-13
7 ♀♀	63.5-67.5	44-69	12-13

Weight: ♂♂ 18.5-21, ♀♀ 17-19.5 gr.

Range: Barrail Range in western Naga Hills, and presumably Cachar.

Siva cyanuroptera cyanuroptera Hodgson : Bluewinged Siva.

A bird of evergreen or thick second growth mixed deciduous and evergreen from 4,700-6,000 ft. I often heard the species making a very chick-like 'cheep'. Males weighed from 16.5-18, a female 15.5 gr.

Yuhina castaniceps conjuncta (Mayr) : Chestnutheaded Staphidia.

The little staphidia was found by us in the eastern Naga Hills only and proves to belong to the subspecies described by Mayr (1941) from the Myitkyina District of Burma, an extension into India of this form. These little crested birds flock through the deciduous trees from 2,000-4,000 ft. chittering and chattering and busying themselves in the undergrowth so exactly like the yuhinas, that at any distance in behavior and calls they would be indistinguishable. I feel that they belong to this group (in which they were first described by Horsfield and Moore) rather than in *Siva* where they were placed by Delacour (1946). The bill of this species is identical with *Yuhina*, and the only external difference I can find is in the tail which is slightly rounded.

Wing: ♂♂ ♀♀ 58-60 mm. Weight: ♂♂ 11.5-12.5 gr.

Yuhina flavicollis rouxi (Oustalet): Chestnutnaped Ixulus.

Specimens collected from 4,700-6,500 ft. prove to belong to the subspecies *rouxi*, named from west China, of which *harterti* (Harington) is a synonym. It is a somewhat more richly coloured form than typical *flavicollis*, particularly in the colour of the chestnut nape, the back and a slightly richer yellow wash on the underparts. From *baileyi* it differs by a darker crown and somewhat more suffused underparts, particularly in the rich olive-brown wash on the lower flanks and thighs. The differences certainly do not appear as striking as outlined in the 'Fauna' (loc. cit., p. 322-23).

Weight: ♂♂ 15.5-19, ♀ 16 gr.

Yuhina gularis gularis Hodgson: Stripethroated Yuhina.

Small flocks of this pretty rich brown crested yuhina with a noticeably buffy-mauve breast moved about restlessly in the tops of the oaks, maples, birches, and rhododendrons on Mt. Japvo. They have a reiterated rather mournful tinkling call. Soft parts: iris clay brown; bill, upper mandible dark brown, lower, basally brownish-yellow, distally dark brown; feet yellow, brownish-yellow, brownish-flesh. Weight: ♂♂ 20.5-24, ♀ 19 gr.

Yuhina nigrimenta nigrimenta Blyth: Blackchinned Yuhina.

The little Blackchinned Yuhina was common in small flocks along the trail from 2,500-3,000 ft. east of Phek, the only area we came across it. It is busy and noisy in the light scrub and deciduous second growth along the trail, sometimes in the tall grass which grows under the trees. Soft parts: iris brown; bill upper mandible black, lower and gape pink, tip of lower mandible brown; feet pale brown. Weight: ♂♂ 9,10, ♀♀ 8,9 gr.

Yuhina zantholeuca zantholeuca (Blyth): Whitebellied Erpornis.

A single female taken at Phek weighing 12 gr. was our only record of this species.

Alcippe castaneiceps castaneiceps (Hodgson): Chestnutheaded Babbler.

A series of 15 specimens of the Chestnutheaded Babbler seem entirely indistinguishable from typical *castaneiceps*, with the distinction that birds from eastern Nepal eastward tend to be very slightly richer coloured in fresh plumage as I pointed out (1950). There is every sort of variation in this species, and post-mortem changes are great. Wear also is important, and the recent description of *garoensis* Koelz (1951) from birds taken in February, sounds like worn birds. The race *brunneicauda* (Sharpe), described from a single old skin from Shillong, and given a range; 'Khasia Hills, Cachar Hills and probably Manipur', by Baker (loc. cit., p. 289), must presumably be the form we found so common on Mt. Japvo which is the same Barrail Range as the North Cachar Hills. These birds are typical *castaneiceps*, showing a characteristic variation in the colour of the crown, back, underparts, edge of wing, and size of malar stripe.

Soft parts: iris reddish brown; bill, upper mandible dark brown, lower grayish-brown; feet yellowish-brown brownish-yellow. Weight: ♂♂ 10-11, ♀♀ 8-11 gr.

Alcippe vinipectus austeni (O.-Grant): Godwin-Austen's Fulvetta.

A pair collected among the gnarled branches of rhododendrons at 9,000 ft. on Mt. Japvo were the only specimens seen by us. Hume (1888) records Godwin-Austen as having obtained the species at the same altitude on the same mountain in the winter of 1872-73. These two birds measure: wing ♂ 58, ♀ 56; tail ♂ 56, ♀ 57; culmen ♂ 10.5, ♀ 10 mm. Soft parts: iris clay colour; bill, upper mandible dark brown, lower light brown; feet brownish-white. Weight: ♂ 12.5, 11 gr.

Mayr (1941, p. 79) described *perstriata* from the North Burma ranges between the upper Chindwin and Irrawady Rivers without mentioning *austeni*. It is perhaps worthwhile here to record that *perstriata* differs from *austeni* in the darker, more blackish streaking on the throat, which in *austeni* is rufous-brown. The ear coverts of *perstriata* also are more blackish. In *perstriata* the white superciliary begins at the lores. In *austeni* this starts over the eye, and anterior to that there is merely an indication of a stripe in a rather grayish suffusion to the upper blackish part of the lores. The black edging above the white superciliary seems somewhat more extended back to the nape than in *austeni*. The rest of the plumage is similar in colour tone and the two forms are in fact rather close. I itemize the differences between them, as these are perhaps the only freshly-collected skins of *Alcippe vinipectus austeni* at present in collections.

Alcippe cinereiceps manipurensis (O.-Grant): Manipur Fulvetta.

As the original specimens of this species in the British Museum are so totally foxed as to be quite useless for any colour comparison it might perhaps be worth while to describe the three specimens of this form obtained by us on Japvo and Zephu. Above, these birds are between hair brown and broccoli brown on the crown shading to a slightly paler tone on the back. The rump and outer edges of the secondaries are tawny olive. There are seal brown superciliary stripes prolonged back to the beginning of the nape. Below, the birds are drab or ecru-drab with tawny olive flanks and thighs with distinct mummy brown or mars brown streaks on the throat and upper breast. The outer edges of the primaries are silvery-gray.

Measurements: wing ♂♂ 55.5, 56, ♀ 51.5; tail ♂♂ 52.5, 53.5, ♀ 49.5; culmen ♂♂ 10, 10.5, ♀ 10 mm. Weight: ♂♂ 10 (2), 9.5 gr.

Soft parts: iris ♂♂ yellowish-brown, pale pinkish-brown, ♀ brown; bill ♂♂ black, ♀ dark brown; feet ♂♂ brown or grayish-brown, legs dark brown, ♀ brownish-flesh.

These birds were taken from 8,000-8,200 ft. in thick evergreen forest, high in the trees. One which I shot was making a tit-like 'cheep' call.

Alcippe dubia mandellii Godwin-Austen: Assam Tit-babbler.

We ran across small parties of these prettily-patterned Tit-babblers from 4,700-6.000 ft. often associated with *Stachyris* species, in thick bushes and heaps of brush. Males and females weighed from 16.5-19 gr.

Alcippe nipalensis commoda Ripley: Nepal Babbler.

Males and females of this form were taken from 3,500-4,800 ft. in pasture land and areas of cut-over scrub. Males and females have wing measurements from 57-61 mm. Weight: 13-16 gr.

I was disappointed not to run into the slightly larger quaker-babbler, the type locality for a race of which, *fusca*, is the Naga Hills.

Heterophasia gracilis (McClelland): Gray Sibia.

This delicately coloured bird was a prominent feature of the Naga Hills from 4,500-7,500 ft. in open deciduous forest, in isolated trees near habitations, and in thick jungle of evergreen type, feeding with bulbuls or associating with mixed hunting parties. The eastern Angami name is 'Titi', perhaps with reference to its chattering call.

Soft parts: iris red, reddish-brown, to brown; bill black; legs dark brown to black, pads yellow.

Weight: ♂ ♀ 34-42 gr. Wing: 10 ♂ ♀ 84-95 mm. I prefer to maintain *gracilis* as a distinct species.

Heterophasia pulchella (Godwin-Austen): Beautiful Sibia.

These freshly collected specimens of *pulchella* from the type locality of the species, the Naga Hills, prompted me to examine the race *coeruleotincta* Rothschild (1921). From rereading the original description I can only presume that very old foxed specimens of *pulchella* were used for comparative material, which possibly was the case. In fresh plumage, nominate *pulchella* is bright 'blue-grey' on the head and back to quote the original description of *coeruleotincta*, 'the primaries being edged with brighter blue, and in the central rectrices being olivaceous amber-brown' etc. The description of the Yunnan form in fact reads like the description of *pulchella*. There is no real difference in size, 10 males and females having wings of 88-104 mm., in contrast to four males and females in the type series having wings of 93-104 mm. Weight: ♂ ♀ 35-47 gr. From the above it would seem useful to synonymize the name *coeruleotincta*.

This species was found only in the tree tops in evergreen forest from 7,700-8,600 ft.

Subfamily SYLVIINAE

Seicercus affinis (Hodgson): Allied Flycatcher-warbler.

A male from Mt. Japvo taken at 7,700 ft. with a flock of other warblers and babblers, has a wing measurement of 58 mm. Soft parts: iris brown; bill, upper mandible dark brown, lower yellow; feet yellow. Weight: 8 gr.

Seicercus burkii burkii (Burton): Blackbrowed Flycatcher-warbler.

During our stay in the Naga Hills we found only three specimens of this form from 4,700 and 7,700 ft. in heavy forest. Weight: ♂ ♀ 7-8 gr.

Seicercus xanthoschistos tephrodiras Sick: Mt. Victoria Grayheaded Flycatcher-warbler.

This is a darker more richly coloured form than typical *xanthoschistos*. This gray-headed and gray-backed little yellow warbler was a common feature along the trail east of Phek from 3,500-4,900 ft. in the deciduous trees which overhung the path. They were quite silent, but flitted busily in the trees at medium heights overhead. Weight: 6.5-7 gr. Wing: 6 ♂ ♀ 51-54 mm.

Seicercus castaniceps subsp.: Chestnutheaded Flycatcher-warbler.

A single male taken on November 9th on Japvo at 7,700 ft. is our only record of this species. Unfortunately it was later mislaid, probably in the packing of our material. It was in medium height trees with a flock of hunting warblers and babblers. The call was quite distinctive, a very loud wren-like 'tsick' which immediately attracted my attention to it. Soft parts: iris brown; bill upper mandible dark brown, lower yellowish-brown, feet light brown, pads yellow. Weight: 6 gr.

Recently Koelz (1951) has described a race *nagaensis* from one specimen taken at Kohima not differing in size but in colour as follows: 'chestnut on crown much deeper, so much so that the lateral stripes on crown are not very prominent; the white spot on the nape is very much reduced; the gray above extends almost to the middle of the back; the white on the abdomen is much more extensive.' As true *castaniceps* is found all over the area south to Manipur and the Chin

Hills, and as colour variation is likely to exist when only one specimen is considered, I am inclined to doubt the validity of this form, which, as proposed is confined to a range of a sort of 'island' in a sea of typical *castaniceps*.

Seicercus poliogenys Blyth: Graycheeked Flycatcher-warbler.

A male of this little flycatcher-warbler weighed 7, two females 6 gr.

Phylloscopus pulcher pulcher Blyth: Orangebarred Willow-warbler.

We came upon this willow-warbler occasionally in heavy forest from 4,700-8,600 ft., always in evergreen, sometimes immensely high on the tops of the biggest trees. It seemed not to be a part of the large mixed hunting parties, but usually just in willow-warbler groups. Males and females weighed 5-7 gr. Soft parts: iris brown; bill blackish or dark brown, base of lower mandible yellowish-brown or yellowish-horn; feet brown, dark greenish-brown, yellowish-brown, pads yellow.

Phylloscopus inornatus inornatus (Blyth): Crowned Willow-warbler.

Taken by us from 2,500-4,700 ft. in open deciduous scrub, usually rather high in the trees. Males and females weighed from 5-7 gr.

Phylloscopus inornatus mandellii (Brooks): West China Crowned Willow-warbler.

This rather darker willow-warbler is indistinguishable from the former in the field and seemed to occur in the same areas, but more commonly. Eight specimens were taken to the five of *inornatus*, from 2,500-6,000 ft. Weight: 4.5-6 gr.

Phylloscopus proregulus newtoni Gaëtke: Pallas's Himalayan Willow-warbler.

As I pointed out (1950) this name is available for the darker eastern population of this willow-warbler, as *chloronotus* must be confined to Nepal. A common species from 3,500-7,000 ft. in mixed deciduous and evergreen association, sometimes in small trees beside the trail, at other times high up in denser growth. Found in mixed flocks with *Chloropsis*, *Heterophasia gracilis*, *Picumnus*, and *Parus monticolus*. Weight: 11 ♂♂ ♀♀ 4-6 gr.

Phylloscopus maculipennis maculipennis Blyth: Grayfaced Willow-warbler.

A bird of thick forest from 6,000 ft. up. We found these birds high up in the trees with mixed babbler-warbler hunting flocks. Weight: 4.5-6 gr.

Phylloscopus reguloides assamensis Hartert: Crowned Willow-warbler.

A bird of forest, found in mixed parties from 4,700-7,700 ft. I recall it making typical 'cheep' notes in a flock of *Alcippe* and *Stachyris* in light scrub and low second growth pasture land near a village.

Orthotomus sutorius luteus Ripley : Mishmi Tailor-bird.

The tailor-bird taken by us from the Naga Hills and northern Manipur is darker, more rufous on the forehead and forecrown than topotypical *patia* from Nepal, and matches *luteus* from the Mishmi Hills. It is also more richly washed with buff below than in *patia*. A female from near Yisi at 3,500 ft. weighed 7.5 gr., a Manipur female 8.5 gr.

Orthotomus cucullatus coronatus Blyth: Yellowbellied Tailor-bird.

A single sex undetermined specimen is indistinguishable from Sikkim birds. Soft parts: iris brown; bill upper mandible black, lower basally orange, distally horn; feet brownish flesh. Weight: 6 gr.

Prinia hodgsoni rufula Godwin-Austen : Himalayan Gray-breasted Wren-warbler.

In the tall weeds and grass from 2,900-4,500 ft. we came across these active little wren-warblers in small flocks. It was less common than the following species. Weight: ♂ ♀ 5-7 gr.

Prinia rufescens rufescens Blyth : Assam Wren-warbler.

A very common bird along the trail east of Phek from 2,500-5,000 ft. in patches of light grass under clumps of deciduous trees. Often found in mixed hunting parties with *Alcippe*, *Stachyris*, and other babblers. We heard it often make rather harsh grating or churring trills. Eight males and females weighed from 6.5-7 gr. Wing: ♂♂ ♀♀ 42-46 mm.

Prinia atrogularis khasiana (Godwin-Austen): Austen's Hill-warbler.

A young male, subadult and very rufous above, was taken near Kohima in mid-October, and an adult female at Phek. The birds have a rather grating series of low call notes. We found them in long grass on the edge of cultivated patches on the steep hillsides. Weight: ♀ 11.5, young ♂ 9 gr.

Cettia montana fortipes (Hodgson): Strong-footed Bush-warbler.

In tall grass along the trail beyond Phek we ran into these shy skulking bush-warblers, behaving in a very wren-like way in the tall grass, usually almost impossible to see. They called simply a single alarm note, 'tsick'. Soft parts: iris brown; bill dark brown, base of lower mandible pinkish-horn; feet pale brownish-flesh, or yellowish-brown. Weight: ♂ 10, ♀♀ 7.5, 9.5 gr.

Cettia flavolivacea alexanderi (Ripley) : Naga Hills Aberrant Warbler.

Two specimens of this dark olive-buff subspecies were collected along the trail beyond Phek in tall grass. We heard definitely only a 'tsick' call from this form, but several times we heard a short grating song which Alexander found very reminiscent of what he had been told was *flavolivacea* in west China. This is a much darker bird than typical *flavolivacea* of the Himalayas, more richly coloured than *weberi* of Mt. Victoria and darker, more buffy (especially below) than *intricata*. Weight: ♀♀ 6, 7 gr.

Subfamily MUSCICAPINAE

Muscicapa strophiata strophiata (Hodgson): Orangegorgetted Flycatcher.

The commonest flycatcher in the Hills, taken from 3,500 ft. up, but particularly numerous in the evergreen on Japvo at 7,700 ft. Males weighed from 11-14, females 11-12.5 gr.

Muscicapa parva albicilla Pallas: Eastern Redbreasted Flycatcher.

A male from Kohima weighed 9 gr.

Muscicapa amabilis Deignan: Rustybreasted Blue Flycatcher.

This is a new name (1947) for *Siphia hodgsonii* Verreaux, listed in the Fauna (Vol. II, p. 216, and Vol. VII, p. 132). A single bird in brown plumage, possibly a subadult male was taken on Japvo at 7,000 ft. on the edge of the evergreen. Weight: 9 gr.

Muscicapa hyperythra hyperythra Blyth: Rufousbreasted Blue Flycatcher.

Two females taken on Japvo in the understorey in heavy evergreen forest were noted from the harsh and snapping noise they made as they flew to a perch. Wing 56, 58 mm. Weight: 7.5, 9 gr.

One bird is very rufescent below with a pronounced tawny-buff streak from the lores to the eye-ring. So richly coloured is this specimen that I had difficulty identifying it. The other presumed 'female' weighing 9 gr. is possibly a subadult male as I can just detect the faintest tinge of gray-blue to the forehead area.

Muscicapa sapphira (Tickell): Sapphireheaded Flycatcher.

A single male in the brown-headed stage of plumage was taken in evergreen forest on Japvo at 8,550 ft. It weighed 8 gr.

Muscicapa westermanni indochinensis Ripley: Eastern Little Pied Flycatcher.

I have recently revised this species (1952), hence the name for the darker, more rufous-rumped eastern population of this widely distributed species. A male taken at Phek weighed 10 gr.

Muscicapa thalassina thalassina Swainson: Verditer Flycatcher.

Found by us at 7,000 ft. on Japvo perching on the edge of the forest in old dead trees near cultivation, and hawking for insects. Weight: ♂ 17.5 gr.

Muscicapa solitaris leucops (Sharpe): Whitegorgetted Flycatcher.

A female from Phek is our only specimen of this shy flycatcher. Weight: 11 gr.

Niltava macgrigoriae (Burton): Small Niltava.

Not uncommon in thick scrub near streams from 2,500-4,500 ft. Weight: ♂♂♀♀ 11-13 gr.

Culicicapa ceylonensis calochrysea Oberholser: Grayheaded Flycatcher.

A male from Kohima weighed 8 gr.

Rhipidura hypoxantha Blyth: Yellowbellied Fantail Flycatcher.

Not uncommon on forest edges or in heavy deciduous patches along the trail east of Phek. The distinctive 'cheep' of this busy little fellow always gave him away. Three males weighed 5 gr. each.

Rhipidura albicollis albicollis (Vieillot): Whitethroated Fantail Flycatcher.

Found by us in heavy evergreen forest from 4,100-7,700 ft. Weight: ♂♂♀♀ 9-12 gr.

PARIDAE

Parus monticolus Vigors: Greenbacked Tit.

From 4,300-6,000 ft. this seemed to be the common tit of the scrub pasture land, light deciduous forest, and occasionally on the fringes of heavier jungle. I would characterize the song of this species as a series of three notes, rather musical, 'pling pling pling,' followed by a double note 'tee-eurp'. Weight: ♂♂♀♀ 12-16 gr.

Parus xanthogenys spilonotus Blyth: Blackspotted Yellow Tit.

A male taken at 6,000 ft. in evergreen forest at Phek is our only record for this form. Weight: 18 gr. Wing 77 mm.

Parus modestus modestus (Burton): Yellowbrowed Tit.

A bird of evergreen forest from 7,700 ft. up. Six males and females weighed 7-7.5 gr.

Aegithaliscus concinnus manipurensis Hume: Hume's Redheaded Tit.

A species found by us usually in the pines (*P. longifolia*) from 4,700-6,000 ft. It is reproduced herewith (Plate III) to show the distinctive pattern and dark colour. Weight: ♂♂ 5.5-7, ♀ 5.5 gr.

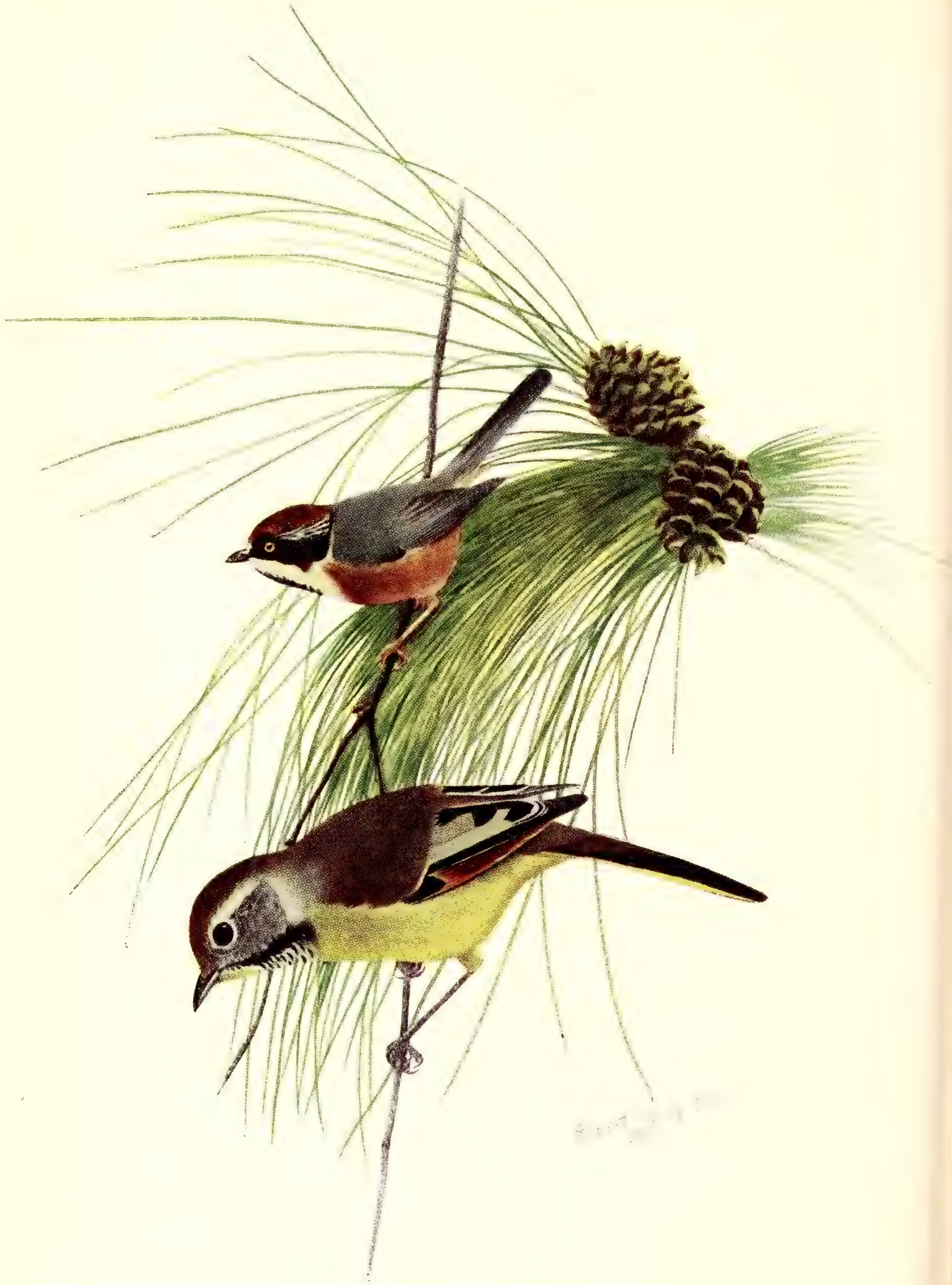
Melanochlora sultanea sultanea (Hodgson): Sultan Tit.

A male taken at 2,500 ft. in deciduous forest near the Tizu River weighed 41 gr.

SITTIDAE

Sitta himalayensis australis Koelz: Naga Hills Whitetailed Nuthatch.

Koelz (1951) describes this new race from the Naga Hills as being; 'underside clear chestnut, deeper posteriorly and fading to white on the centre of throat and chin, quite unlike the nominate race where a paler chestnut is restricted to the vent and flanks, and where the abdomen and breast are rather pale rufous. In *S. h. australis* the postocular stripe stops short on the neck, and is not produced to the shoulders as in the nominate race. Bill stouter in this new race.'



Ægithaliscus concinnus manipurensis Hume
Siva strigula cinereigenæ, subsp. nov.

A male and two females shot by me from 6,000-8,200 ft. east of Kohima when compared with nominate *himalayensis* from the U.P. Himalayas are certainly not noticeably different on the underparts as Koelz maintains, nor is the bill stouter in series. However, the postocular stripe does stop short on the neck, and is not prolonged onto the shoulder as Dr. Koelz rightly points out. This is a bird of evergreen forest. Soft parts: iris brown; bill black, base of lower mandible gray; feet (♂) dark greenish-brown, or, yellowish-brown, (♀) dark brown. Weight: ♂♂ 15, 15.5, ♀ 14 gr. A smallish male (wing 71) of typical *himalayensis* from Kumaon in the collection, taken in January has a weight of only 11 gr.

Sitta europaea nagaensis Godwin-Austen: Austen's Nuthatch.

Two females were taken at Phek and Mt. Zephu at 4,800 ft. in heavy mixed deciduous and evergreen forest. This form is apparently altitudinally separated from its neighbouring forms as Deignan (1945) pointed out in the case of north Siam subspecies, where a dark-coloured population lived at lower altitudes, and a paler-colored population at higher. In this case *nagaensis* is the higher form, and the new race *koelzi* Vaurie (1950), which we did not come across, must inhabit the lowlands. These birds weighed 13.5, 16.5 gr.

Sitta frontalis frontalis Swainson: Velvetfronted Nuthatch.

Four females with wing measurements from 68.5-74 mm. incline me to agree with Vaurie (loc. cit., pp. 11-13) that all Indian birds must be listed in this single subspecies. These birds were taken from 3,000-4,000 ft. in light deciduous growth and weighed 11-14.5 gr.

CERTHIIDAE

Certhia discolor manipurensis Hume: Hume's Tree-creeper.

A pair, from 4,200 and 7,000 ft., the latter on Japvo, the former near Meluri, seem to belong to this slightly darker population. They measure: wing ♂ 69, ♀ 67 mm. Weight: ♂ 11, ♀ 10 gr.

DICAEIDAE

Dicaeum ignipectus ignipectus Blyth: Firebreasted Flowerpecker.

The only common flowerpecker, found from 2,500-8,200 ft. in evergreen as well as light deciduous scrub. Ten males weighed from 4-8, one female 6 gr.

Dicaeum concolor olivaceum Walden: Plaincoloured Flowerpecker.

The second most common species, found from 2,500-3,500 ft. in deciduous jungle and cut-over scrub. Wing: ♂ 43.5-46, ♀ 42.5-44 mm. Weight: ♂♂ ♀♀ 4-6 gr. These birds give an impression of having a slightly stouter, bigger bill on the average than birds from Nepal or the Khasia Hills.

Dicaeum chrysorrheum intensum Baker: Yellowvented Flowerpecker.

A single male from Kohima weighed 9 gr. Wing 59 mm.

Dicaeum agile deignani n. subsp.: Thickbilled Flowerpecker.

Type.—No. 12,960, Yale Peabody Museum, ♀ ad., Kohima, Assam, October 15th, 1950; S. Dillon Ripley coll.

Deignan (1945, pp. 550-1) correctly points out that the Thickbilled Flowerpecker of Assam is brighter and greener above, and creamier below than typical *modestum* (Hume) of Tenasserim, Peninsular Thailand, and Malaya (apparently *remotum* and *finschii* are synonyms).

Compared to typical *agile* of the Himalayas it is more richly gray-green above, and distinctly grayish-creamy rather than grayish-white on the underparts.

Measurements: wing 56.5, tail 29, culmen 9. Weight: 8 gr.

Range: Assam and northern Burma. I have not seen specimens from the Shan States and am not sure where in southern Burma this form meets *modestum*.

This is a bird of open scrub and pasture land.

The subspecies is named in honor of my friend Herbert Deignan.

NECTARINIIDAE

Aethopyga nipalensis koelzi Ripley: Koelz's Yellowbacked Sunbird.

Found from 4,900-8,200 ft. wherever plants were in flower, usually in deciduous or evergreen forest, but sometimes in open pasture land. Wing: ♂♂ 53-55.5; culmen 22-23 mm. Weight: ♂♂♀♀ 5.5-7.5 gr.

Aethopyga saturata assamensis (Horsfield): Blackbreasted Sunbird.

This is a more richly coloured population than topotypical Nepal birds, and so it seems wise to revive Horsfield's name (1839). I suspect that these birds are smaller also; wing: ♂♂ 51, 53; ♀♀ 44-48; culmen: ♂♂ 20, 21; ♀♀ 18-18.5 mm. Weight: ♂♂♀♀ 5-6 gr. The specimens were taken from 3,000 to nearly 5,000 ft. in deciduous forest or open pasture land.

Aethopyga siparaja labecula (Horsfield): Assam Scarletbacked Sunbird.

This is a darker and more richly coloured form than *seheriae*. It does not differ in size. We found them in the hills from 3,750-5,000 ft. in open deciduous forest and scrub jungle. Weight: ♂♂ 6-9, ♀ 6 gr.

Aethopyga ignicauda ignicauda (Hodgson): Firetailed Yellowbacked Sunbird.

Two males in eclipse were taken in open pasture at 5,000 ft. at Phek, and in evergreen forest at 8,200 ft. on Zephu. They weighed 7.5 and 9 gr.

Aethopyga gouldiae isolata Baker: Baker's Yellowbacked Sunbird.

Having looked at Baker's type of *isolata* in the British Museum, I am inclined to agree with Stresemann (1940) that this subspecies was not worth recognizing. It is slightly smaller than typical *gouldiae,* and my specimens from the Naga Hills agree with this diagnosis. However, I would like to retain the name for another more interesting biological reason. Baker in the 'Fauna' (1926) discusses the species *dabryi* and notes that he has taken specimens in Cachar which, from their reddish breasts, he presumes to be this species. These specimens are now deposited in the Sophia Museum. Among the birds taken by us in the Naga Hills is one subadult male moulting into adult plumage which has a great splash of reddish feathers coming in and overlaying the yellow of the breast. It is not symmetrical, being more heavy on one side than the other. From this evidence coupled with that of Baker in Cachar, I should say that there was a polymorphic population here representing a transitional condition between typical *gouldiae* and typical *dabryi.* It may be characterized by slightly smaller size, by a tendency to a paler yellow band on the rump than typical *gouldiae,* and, in the case of *g. dabryi,* by smaller size. The *dabryi* phenotype I think would be otherwise indistinguishable. Evidently this is a question of gene imbalance in an intermediate population. The rarity of *dabryi* phenotypes indicates that the *gouldiae* type has some slight advantage. It would be interesting to determine what percentage of the *dabryi* types may occur in the wild state. I have no data from existing collections beyond my own in which one out of four males showed the presence of this character.

We found this sunbird from 4,000-5,000 ft. at Phek and the trail to the east. They were in deciduous scrub jungle feeding on flowering vines and trees. Wing: ♂♂ 51.5-53; culmen: 15-16.5 mm. Weight: ♂♂ 6-7 gr.

Baker's *isolata* was originally described from Manipur, and the range included the Surma Valley in Cachar, the Lushai Hills and part of the Chin Hills. Baker (1925) noted that red-breasted males came from above 6,000 ft. on Mt. Victoria, but none turned up apparently in the Heinrich collection reported on by Stresemann (loc. cit.). I would list the range of this polymorphic population as: eastern Cachar, Naga Hills south to Manipur, Lushai and Chin Hills.

Arachnothera magna magna (Hodgson): Streaked Spider Hunter.

Found occasionally in *Bombax* trees in flower in the eastern hills from 2,500-6,000 ft. Their loud chatter is unmistakable. Weight: ♂♂ 31, 33, ♀ 25.5 gr.

ZOSTEROPIDAE

Zosterops palpebrosa palpebrosa (Temminck): Indian White-eye.

Six males and females have wing measurements from 51-53 mm., thus fitting in with *palpebrosa* and not *cacharensis* Baker, which was described as 'smaller' and with a distinct yellow streak down the abdomen. One specimen, taken by us in Manipur, is not 'smaller,' but is richly coloured with a distinct yellow streak down the abdomen. One Naga skin has an indication of a yellow streak also. Otherwise these birds are indistinguishable. Males and females weighed 7-10 gr.

FRINGILLIDAE

Carduelis spinoides heinrichi Stresemann: Mt. Victoria Greenfinch.

This subspecies is far darker in colouration than typical *spinoides* of the Himalayas, but paler than *monguilloti* Delacour of Indo-China. We found the greenfinch in some tall eucalyptus planted near the Government Resthouse at Mao, just over the border into Manipur from the Naga Hills, and also on Mt. Zephu in dead trees in clearings at Zephu village at 7,500 ft. Wing: ♂ 75, ♂♂ subadult 72.5, 75, ♀♀ 70-72.5 mm. Weight: ♂ 16, ♂♂ subadult 15, 15.5, ♀♀ (3) 15 gr.

Emberiza pusilla Pallas: Little Bunting.

A female from Mt. Zephu at 4,800 ft. weighed 13.5 gr.

Emberiza spodocephala sordida Blyth: Blackheaded Bunting.

A male taken in tall grass along the Dzulu River east of Kohima at 2,670 ft. represents this richly-coloured form. Soft parts: iris brown; bill, upper mandible black, tomia and lower mandible whitish-horn, tip dark horn; feet pale brownish-flesh. Weight: 18 gr. Only call uttered, 'tsick.'

PLOCEIDAE

Passer rutilans lisarum Stresemann: Mt. Victoria Cinnamon Sparrow.

A male from Japvo with a wing of 69.5 mm. belongs to this small, richly-coloured subspecies. Soft parts: iris brown; bill black, base of lower mandible yellowish-brown; feet brown. Weight: 19.5 gr.

It is worth noting that a male *Passer montanus* taken by us in Manipur appears to belong to the saturate, liver-coloured form, named *hepaticus* by me from the Mishmi Hills.

Lonchura striata acuticauda (Hodgson): Hodgson's Munia.

A single male taken at Phek in the rice fields belongs to this subspecies. Weight: 12 gr.

Lonchura punctulata subundulata (Godwin-Austen): Burmese Spotted-Munia.

Adults and immature birds were collected round Kohima. Weight: 12-13 gr.

DICRURIDAE

Dicrurus macrocercus was not collected by us in the Naga Hills although it was seen once or twice at low altitudes in the fields. However, a female shot in Manipur, proves by its measurements to belong to the Burmese form *cathoecus* Swinhoe, a westward extension for the subspecies.

Dicrurus aeneus aeneus Vieillot: Bronze Drongo.

A pair was taken in light deciduous forest east of Phek. Weight: ♂ 25.5, ♀ 21.5 gr.

Dicrurus paradiseus was seen but not collected in similar biotope.

ORIOLIDAE

Oriolus traillii traillii (Vigors): Maroon Oriole.

Shot in thick secondary growth near the trail east of Phek, I was attracted to this brilliant oriole by the harsh woodpecker-like squawk that it uttered monotonously. Soft parts: iris, ♂ creamy pinkish-yellow, yellowish-brown, ♀ brown; bill, ♂ pearl gray; ♀ gray; feet, ♂ gray or bluish-gray, ♀ slaty-gray. Weight: ♂ 67, 74, ♀ 68 gr.

CORVIDAE

Kitta chinensis chinensis (Boddaert): Green Magpie.

A male shot below Kohima at 3,500 ft. weighed 130 gr.

Crypsirhina formosae himalayensis (Blyth): Himalayan Tree-pie.

The only abundant tree-pie in the Naga Hills. I saw the Red-billed Blue Magpie (*Kitta erythrorhyncha*) east of Phek, but failed to secure a specimen. This Tree-pie was shot from 3,500-5,700 ft. Wing: ♂♂♀♀ 134-147 mm. Weight: ♂♂ (2) 108, ♀♀ 97-107 gr.

Garrulus glandarius interstinctus Hartert: Sikkim or East Himalayan Jay.

Comparing this jay throughout its range west and east in the Himalayas, it seems just possible to separate it into two races. There is no difference in size, and the colour of the upperparts is truly variable when series are laid out together. Some birds from the U.P. Himalayas are just as dark as are some from, for example, the Naga Hills. It does seem to me that the brown patch on the innermost tertial is slightly darker in the eastern part of the range, and that the banding on the outer webs of the secondaries is more widely spaced in these eastern birds. I cannot recognize *persaturatus* Hartert from the Kasia Hills, nor the recent *azureitinctus* Koelz (1951) whose range is given as: 'Southeastern Assam, and probably also northeastern Assam.'

A pair from beyond Phek were shot in deciduous cut-over forest at 4,500 and 4,900 ft. A group of small birds were mobbing one of these jays. Weight: ♀ 130 gr. Wing: ♂ 173, ♀ 164 mm.

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NOTES ON THE GREY MULLETS (*MUGIL* SPP.) OF KRUSADAI ISLAND, GULF OF MANAAR *

BY

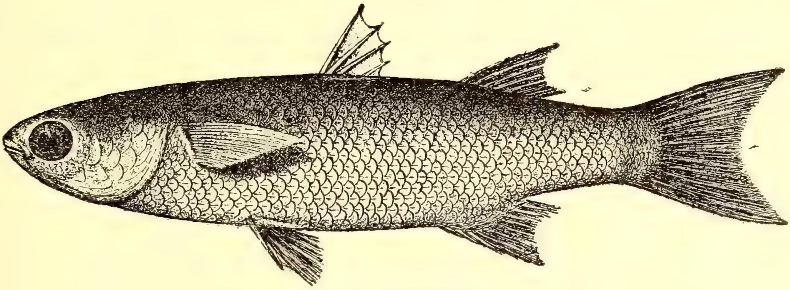
K. CHIDAMBARAM & G. K. KURIYAN

(*Marine Biological Station, Krusadai Island, Pamban*)

(*With a text figure*)

Grey Mullets (*Mugil* spp.) constitute an important group of fishes hugging the shores of Krusadai and nearby islands in the Gulf of Manaar. The mullet fishery extends throughout the year. The fish is caught in comparatively shallow water at flood tide, with cast and drag nets. The following three species have been found to predominate in the commercial catches:

1. *Mugil troschelii* (Blkr.)
2. *M. waigiensis* (Quoy & Gaim.), and
3. *M. seheli* (Forsk.)



Mugil seheli Forsk.

These species are being studied in detail in view of their importance for cultivation in marine, brackish water and fresh water-farms. In this note are embodied certain details of their bionomics.

Food of Mullets: The diet of mullets in Krusadai area, as revealed by systematic analyses of 101 specimens of each of the three species, is presented in the following Table I.

The food consists mainly of planktonic organisms. Diatoms formed on an average 65 to 75% of the total volume of the gut contents. The

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* Read before the 37th Session of the Indian Science Congress and published with the kind permission of the Director of Fisheries, Madras.

TABLE I

Name of species	Size range of fish examined	Gut contents		
		Plankton		Miscellaneous items
		Phytoplankton	Zooplankton	
1. *M. troschelii*	15 to 37·5 cms.	Diatoms: mainly *Thalassiothrix*, *Pleurosigma*, *Nitzschia*, *Coscinodiscus* & *Navicula*; and algal matter; filmamentous algae & *Trichodesmium*.	Copepods and Polychaete worms	Polychaete moults; foraminiferan shells and sand
2. *M. waigiensis*	17·5 to 42·5 cms.	Diatoms: mainly *Thalassiothrix*, *Pleurosigma*, *Nitzschia*; & *Coscinodiscus*; and algal matter: *Trichodesmium*	Crustaceans: Ostracods & Copepods and Polychaete worms	Foraminiferan shells and sand
3. *M. seheli*	12·5 to 22·5 cms.	Diatoms: mainly *Thalassiothrix*, *Coscinodiscus*, *Phizosolenia* & *Nitzschia*; and algal matter: *Trichodesmium* & filamentous algae	Polychaete worms	Foraminiferan shells and sand.

usual outward appearance of the stomach was slightly greenish. In several instances the stomach and intestines were virtually gorged with diatoms. A large percentage of the *M. waigiensis* examined showed a comparative abundance of the alga *Trichodesmium erythraeum* in the stomach. The presence of formaniferan shells and sand is suggestive of the possible and occasional browsing habit of mullets at the substratum.

Food of fry of Mullets: The stomach contents of the fry show that they are surface and mid-water feeders. The analysis of the gut contents is given below in Table II.

TABLE II

Name	No. of specimens examined	Phytoplankton	Zooplankton
Fry of *M. troschelii*	50	Diatoms: mainly *Thalassiothrix*, *Nitzschia*, *Pleurosigma*, *Chaetoceras* & *Fragillaria* Algae: *Oscillotaria*	Copepods
Fry of *M. waigiensis*	50	Diatoms: mainly *Pleurosigma* & *Coscinodiscus*; algal filaments and algal spores	Crustaceans: Copepods & *Leucifer*; and larval Polychaetes

The fry of *M. troschelli* take to phytoplanktonic diet with great avidity, while those of *M. waigiensis* feed mainly on copepods. The fry of the latter species showed in many cases a selective feeding, as the stomach was frequently noticed to be full of copepods only.

Breeding Seasons: Examinations of gonads in the laboratory revealed that the mullets have a prolonged breeding period from May of one year to February of the succeeding year. Mullet fry are available for collection in the inshore areas of Krusadai Island almost throughout the year.

Characters of Fry: A provisional key for the field identification of eight species of mullets in the Madras waters as classified by Chidambaram and Venkataraman is given by Job and Chacko (1947) in their paper on ' Rearing of saltwater fish in fresh waters of Madras'. The fry of mullets also present certain difficulties in their identification. In view of the fact that the field identification of the fry of mullets would be of benefit to the pisciculturist, and as the cultivation of mullets in marine and fresh water farms is gaining importance in the country, the need for a key for identification of fry is keenly felt. The distinguishing characters of the fry of *M. troschelii* and *M. waigiensis* are detailed below :

Fry of *M. troschelii.* Dorsal side grey and ventral side silvery; dorsal and caudal fins spotted; a dark blotch at the upper edge of the pectoral fin.

Fry of *M. waigiensis.* Exceedingly shiny and silvery all over, except dark margins of the dorsal fins. The pelvic and pectorals tinged yellow. Grey colour first appears on the dorsal side of the head when about 2 cms. in length, and slowly extends to the dorsal side of the body.

Discussion: Devanesen (1942) is of opinion that the fishery of *M. waigiensis* in the Krusadai area depends to a certain extent on the abundant occurrence of the blue green algae *Trichodesmium* spp. in the plankton. Chacko and Venkataraman (1944) made notes on the food of twelve species of mullets in 'our country'. But unfortunately the information regarding the regions from where those specimens of mullet were collected is not given and that restricts the scope of comparison of their data with what is presented in this paper. But on a closer examination of the data furnished by them on the stomach contents of the twelve species, it is noticed that they were collected in the estuaries and backwaters or in the seas close to the mouths of rivers, as evident from the presence of organisms which are characteristic of brackish and fresh waters. Jacob and Krishnamurthy (1948) have given a few more organisms as forming the diet of *M. troschelii* and *M. waigiensis* than those recorded by Chacko and Venkataraman (1944). Chacko (1949), presenting the food and feeding habits of the fishes of the Gulf of Manaar has recorded the gut contents of *M. troschelii*, *M. waigiensis* and *M. seheli.* In addition to the previous records of the stomach contents of the three species of *Mugil*, the following organisms have been observed in the course of this study.

1. *M. troschelli* — *Trichodesmium* sp. & copepods.
2. *M. waigiensis* — (No new records)
3. *M. seheli* — Foraminiferan shells.

Chacko (1949) suggests that *M. seheli* is a plankton feeder, but it has been observed by us that this species resorts to occasional bottom feeding also, like the other two. The sand and bottom scum are found in the stomach contents of *M. troschelii* in the Krusadai area, but apparently not in Ennore region. The phytoplanktonic organisms of brackish water origin as recorded by the other investigators are not found included in the stomach contents of the three species under examination at Krusadai. Our observations, in general, on the feeding habits of mullets confirm those of the previous workers regarding their planktonic diet and their occasional feeding at the bottom. Regarding the food of mullet fry, Jacob and Krishnamurthi (1948) state that the fry of mullets of Ennore share all the adult characters in their type of food and manner of feeding. The analyses presented above for the Krusadai area show a conspicuous absence of forminiferan shells and sand grains.

There is hence every reason to believe that only full-grown mullets resort to occasional browsing at the substratum.

According to Jacob and Krishnamurthy (1948) 'the mullets of Madras coast breed soon after the commencement of the monsoon' and they have observed the gonads to be ripe from October to May. This indicates that the stimuli for breeding may be certain factors including perhaps those caused by the monsoon. The factors may possibly be physical, like temperature, wind and current; chemical, like salinity and oxygen content; and physiological, like availability of food (diatoms mainly). This aspect is under further investigation and the findings will be presented separately.

Summary: Grey mullets constitute an important group of fishes hugging the shores of Krusadai and nearby islands in the Gulf of Manaar. The three important species constituting the fishery are (1) *M. troschelii* (Blkr.), (2) *M. waigiensis* (Quoy and Gaim.) and (3) *M. seheli* (Forsk). The food of the adult and fry of the first two species are presented and discussed. The characters for identifying in the field the fry of *M. troschelii* and *M. waigiensis* are given in view of their importance for pisciculturists, since the cultivation of mullets in marine and fresh water farms is gaining more importance in this country than ever before.

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CONTRIBUTIONS TO THE BIBLIOGRAPHY OF INDIAN BOTANY

BY

H. SANTAPAU, S.J.

PART I

The present paper is intended as a complement to Blatter's 'A Bibliography of the Botany of British India and Ceylon' published in this Journal (20: lxxix - clxxvi, 1909). Such bibliographical lists are of great help to students, but unfortunately they are all too rare in India.

Pritzel with his *Thesaurus Literaturae Botanicae* (1851) set the fashion in this line; he has been followed by a distinguished succession of authors in many countries, especially in the U.S.A. Indian literature on the subject is very meagre; in addition to the paper by Shaw and Bose cited below and a few minor ones, we can show nothing to compare with the numerous contributions from foreign countries. The directors of UNESCO have realised our position, and how seriously we are hampered in our work by this want of literature, and this is why they have recently undertaken the publication of an interesting series of bulletins of great promise.

The following list has been somewhat differently planned from that of Blatter; the division of the country into floristic regions may be a logical one, but makes reference rather difficult and often confusing. All my references to general or local floras have been alphabetically arranged in Part I; Part II lists a number of monographs or papers dealing with families, genera or even individual species, the families being arranged in alphabetical order, and within the family references follow the alphabetical order of their authors' names. My scope has been restricted to the Phanerogams, and in consequence ferns, mosses, etc. are left out; further, as a rule only papers of taxonomic or systematic interest are given here, other papers on anatomy, morphology, cytology, etc. are only mentioned in so far as they may be considered to be of interest for the study of taxonomy.

In general, works listed by Blatter in his Bibliography have been omitted here; where the title of the work or paper is incorrectly or incompletely given by Blatter, it is here corrected to the best of my information. Many of the references in Part II are to books which at first sight may appear to have nothing to do with India; as a rule, however, only monographs dealing with families represented in India are inserted here. Among the foreign books or papers in my list, it will be at once clear that many deal with the flora of Malaya or of the Dutch East Indies; such papers have been carefully studied and found of great help in the study of our Indian flora; in this respect the various contributions from the Buitenzorg botanic garden that have appeared either in the *Bulletin du Jardin Botanique*, Buitenzorg, or in *Blumea* deserve careful study and attention.

Materials for the present paper have been collected in the course of a number of years; but it was mainly during my long stay in Kew that most of the references were seen and checked. At first it was my intention to publish a comprehensive list of the papers on which my Flora of Khandala had been based, and to append such a list as a bibliography to my book. Gradually, however, my plan expanded so as to include books or papers dealing with plants not only of Khandala but also of other parts of India. Ceylon, Burma and Pakistan have been left out of my list, first because politically they no longer form part of India, and secondly because with the omission of these countries our Indian flora, and consequently its bibliography, have become a much more homogeneous and compact unit.

Most of the references here given have been personally checked by the author in Kew or elsewhere; a good number of the papers given in this list can be seen in St. Xavier's College, Bombay, either in the original, or in photographic copies or in fairly lengthy MS. abstracts.

The author does not claim to have exhausted the subject; the references here given have been of great help to him and it is hoped that they may also be of help to other Indian botanists in their systematic work on Indian plants.

In conclusion, it is the author's pleasant duty to express his sincere gratitude to Mr. H. S. Marshall, the librarian, Royal Botanic Gardens, Kew, for the great kindness with which he has often come to the author's help in his search for references dealing with Indian plants.

ABBREVIATIONS

In order to save space, the titles of the more common journals have been shortened from the usual internationally accepted forms to but a few letters. The following are the more commonly used abbreviations of this type:

ARBG	Annals of the Royal Botanic Garden, Calcutta.
Buitenz.	Bulletin du Jardin Botanique. Buitenzorg, Java.
JB	Journal of Botany, British and Foreign. London.
JBNHS	Journal of the Bombay Natural History Society. Bombay.
JIB	Journal of Indian Botany *or* Journal of the Indian Botanical Society.
JLS	Journal of the Linnean Society, Botany. London.
TLS	Transactions of the Linnean Society, London.
RBSI	Records of the Botanical Survey of India. Calcutta.
Pfreich.	Engler's Das Pflanzenreich.
Pfam.	Engler and Prantl's Die Natürlichen Pflanzenfamilien.

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(*To be continued*)

STUDY OF THE MARINE FAUNA OF THE KARWAR COAST AND NEIGHBOURING ISLANDS

EY

A. M. PATIL, M.SC.

(*Department of Zoology, Karnatak College, Dharwar*)

PART II : MOLLUSCA—AMPHINEURA AND GASTROPODA

(*Continued from p.* 139 *of this volume*)

INTRODUCTION

The present paper is the second of a series of papers devoted to the systematic study of the marine fauna of the Karwar Coast and neighbouring islands. The Karwar Coast is especially rich in the molluscan fauna and hence it was thought desirable to deal with only Amphineura and Gastropoda in the present paper. The remaining groups of Mollusca will be dealt in a subsequent paper.

SYSTEMATICS

MOLLUSCA

Mollusca are the most abundant of all the animals found in the littoral regions of Karwar. A large variety of them have been collected from all the different localities, either in the living condition or as empty shells. The oysters and clams are by far the commonest of the molluscs of Karwar and they form a major part of the food of the coastal population.

Representatives from all the major classes of the phylum have been recorded except members of the group Solenogastres.

PLACOPHORA :

Chitons have not been observed in appreciable numbers. The only genus recorded is *Acanthochitona* found on the rocks between tide marks in Kamat's bay, Binge bay and Kurmugad island. These animals are recognised by the presence of bundles of spicules along the edge of the mantle, arranged in tufts.

GASTROPODA :

Gastropods are very well represented all along the coast and the live animals recorded are as numerous as the empty shells collected. The following are the families recorded :

Patellidae;

Limpets are quite abundant in Karwar and are found living between tide marks on rocky coasts. They live so near the high tide mark, that during low tide they are left stranded high and dry. Though edible, they are not used as food along this coast. However, some people in Anjadiv island have been seen collecting them for food. The following three species are the most common in Karwar: *Patella variabilis* (Sowerby), *P. reynaudi* (Deshayes) and *P. nimbus* (Reeve).

Haliotidae:

The Ear-shells are flat, oval and limpet-like, with a row of holes on the outer posterior margin of the shell, the anterior ones being closed. A low indistinct spire is recognised at the anterior end. Only a few dry shells of *Haliotes varia* (Linnaeus) have been collected.

Fissurellidae:

As these animals live below or at the low tide mark, the majority of them are seen only as shells washed ashore.

Clypidina notata (Linnaeus) is the most common Fissurellid of Karwar and is found in large numbers along with the true limpets, but generally at a lower level. Its shell is conical and violet in colour with deep ribs and narrow white grooves radiating from the apex. The shell has no hole or slit and may be mistaken for that of *Patella*. Its fissurellid characters are revealed only by the study of the internal anatomy.

Diodora has a smaller, but more elongated brownish shell with a slit at the apex. They live below the low tide level and only dry shells washed ashore have been collected.

Emarginula has a thinner and more flat shell with a slit at the posterior margin. They too are known only by the dry shells that have been washed ashore.

Scutus is again known only by the dry shells washed ashore and is similar to *Emarginula*, but is thinner, narrower, longer and has no slit. Its front margin is slightly concave.

Trochidae:

The Trochidae found in Karwar are quite small in size and are found on rocks between tide marks. Five representatives of this family are known.

Trochus is the most common and has a bigger shell with red and brown markings. Both empty shells and live animals have been collected.

Calliostoma has a shell similar to *Trochus* in shape, but is delicate and shows a sharply pointed apex. Only empty shells have been collected.

Euchelus has a shell smaller than *Trochus* and its whorls are bulged. Both live animals and empty shells are known.

Umbonium is small, half an inch or less in diameter, and has a shell with a very low cone. The shell is polished and brightly coloured. They are found in large numbers in the extensive sandy areas, which are submerged during high tide.

Minolia has a slightly larger shell with a higher spire and bigger aperture than *Umbonium*. The surface of the shell is sculptured or decorated with spiral ridges. These animals are found living on rocks.

Turbinidae:

Turbo is the only genus represented from this family. The shell has a high spire and swollen whorls arranged like a tapering turban. Its operculum is heavy, calcareous and is shaped like a plano-convex lens. The animals are collected from the rocks and many a time the opercula are seen washed ashore in good numbers.

Neritidae:

Nerita are found in large numbers on the rocks. They have a heavy swollen shell with a low spire and no umbilicus. A very closely allied form with a similar, but smaller and thinner shell, is *Neritina*, which is found in the estuary, while *Nerita* is exclusively marine. *Neritina* is found in large numbers on the mud-banks of the river Kalinadi. A series of transitional forms, ranging from the very highly saline to the very pure freshwater regions are represented by this genus.

Architectonidae:

Architectonica has a shell with a wide low cone and an open umbilicus, the margin of which gives the impression of a spiral staircase, hence the name 'staircase shell'. Only a few empty shells have been collected.

Epitoniidae:

The animals of this family have more or less elongated shells with distinct whorls, and they possess a horny operculum. Animals belonging to the following two genera have been collected in Kamat's Bay.

Epitonium has a shell whose whorls are swollen and encircled by transpiral ribs. Only one live animal was collected on a rock.

Eglisia has a shell with the base of the body whorl flattened and has spiral lines and radial sculpture on it. Only a few empty shells have been collected.

Fasciolariidae:

These animals possess spindle-shaped shells with an elongated anterior canal. The operculum is horny. Two genera are known in Karwar.

Fasciolaria is more or less like the sacred chank, but the anterior canal and the spire are comparatively longer. They live in slightly deep waters and can be collected by dredging.

Fusinus has typically a fusiform or spindle-shaped shell with a very long spire and a long beak, and the whorls are gracefully rounded. The shell is sculptured with longitudinal and transverse striations. These animals were also collected in large numbers by dredging.

Volemidae:

Hemifusus is the knobbed chank, the knobs being very conspicuous. They have a long anterior canal with a comparatively short spire. The shells are very massive and grow to a large size. A few large specimens are usually found in the nets brought to the shore.

Mitridae:

Mitra has a beautiful elongated spindle-shaped shell without an operculum. The surface of the shell is ornamented with coloured spiral lines and spots. A few dry shells have been collected on the beaches.

Buccinidae:

The animals included in this family, commonly known as Whelks, have an oval shell with more or less an oval aperture. The foot is large with a horny operculum.

Babylonia spirata (Linnaeus) has a smooth shell with brown patches on a pale background. The grooves separating the whorls are broad and deep, giving the spire an appearance of a tower with successively decreasing stories. These animals are found in sandy and muddy areas below the low tide mark. They are usually collected by dredging or are brought to the shore in the fishermen's nets.

Engina is quite small with the shell having tuberculated ribs and a very small operculum. The tubercles are brownish in colour on a pale background. These animals are littoral in habitat.

Nassidae:

The animals belonging to this family possess shells with short anterior canals and horny opercula. They have a large and broad foot and a long siphon. Two genera are represented in Karwar.

Nassa has a shell with a large aperture and in the majority of species, the shells have transpiral grooves or lines. They have been collected in Kamat's and Binge bays.

Bullia have thinner shells with taller and more slender spires. They live burrowing in the sand near the low tide level. They have always been found in large numbers in Kamat's Bay. With the receding waves they are often left exposed, when it is common to see them rapidly burrowing into the sand with their large leaf-like foot. When handled, these animals squirt a quantity of water through an aperture in front of the foot and then only can the foot be contracted and withdrawn into the shell. It is interesting to note that, though thousands of these animals are found in live condition all round the year upon this shore, only a few empty shells have been seen cast ashore. The presence of some predacious animal which feeds upon these snails has been suspected.

Muricidae:

The shells of these animals are solidly built and in many species the varices are ornamented with tubercles or spines. The spire of the shell is usually shortened and the body-whorl is large. Their foot is large and the operculum is horny. Three genera, with several species in each, are well represented in Karwar.

Murex is recognised by its long anterior canal and distinct varices. One species, *M. tribulus* (Linnaeus), which bears long slender spines, is occasionally brought ashore in the nets entangled by its spines. Another species is collected in the muddy areas, which has a thick shell with a moderately long anterior canal and the varices bearing tubercles.

Rapana has a large and thick shell with a spiral line of small tubercles, a large umbilicus and a low spire. It is common on the rocks between tide marks.

Thais shells are thick and generally their longer diameter equals the height of the spire. The whorls are characterised by lines and tubercles. There are several species of *Thais* in Karwar. They are littoral, gregarious and found under or between rocks and stones. Egg-capsules of *Thais* have been found attached in clusters to rocks and many a time to molluscan shells which are washed ashore. Each capsule is about half an inch in length and is shaped like a straw-coloured vase with purple edges.

Cancellariidae:

Cancellaria has a moderate-sized shell with rather small ribs and no operculum. Only one live animal was collected on a rock in Kamat's Bay.

Pyrenidae:

Pyrene have short spindle-shaped solid shells about an inch in length and may be mistaken for the shells of *Engina* (Buccinidae). The *Pyrene* shell has a longer spire, narrower aperture and is more spindle-shaped. It is usually found living along with *Engina*.

Olividae:

The Olives are found actively burrowing into the sand, probably in search of bivalves on which they feed, and a number of them have been collected in Kamat's Bay. The shell is cylindrical in shape, like an olive fruit, with a low spire and a narrow mouth opening. The foot is large with no operculum. The surface of the shell is highly polished and beautifully coloured like marble. There is no periostracum over the shell, because it is normally covered by the expanded foot and mantle, which are responsible for maintaining the polish. Two genera are represented in Karwar.

Oliva has a bigger and heavier shell with a variety of coloured markings.

Ancilla has a comparatively slender shell with uniform colouring, and in one species, *A. ampla* (Gmelin), the shell has a dark brown apex.

Harpidae:

Harpa has an inflated shell with a short spire, beautifully coloured and presenting a number of longitudinal ribs appearing like the strings of a harp; hence the name. A single dry shell was collected on Karwar beach.

Conidae:

Conus, as the name implies, has a cone-shaped shell with a very short spire, almost flat, forming the base of the cone. They have a long and narrow aperture and a claw-shaped operculum. They are brilliantly coloured and have been collected from Baitkal Cove and Kamat's Bay.

Littorinidae:

Littorina is found all along the coast in Karwar, living in groups of hundreds on rocks and other habitats. Their shells are small, whelk-shaped, but the aperture is rounded at the anterior margin. The foot is divided longitudinally into two halves, each moving alternately forward. The shells are protectively coloured like their background. They are found in large numbers living on rocks below and above the high tide level, and they are also found living in the estuarine regions. The peculiarity about these animals is that they are able to live a long time out of water. This semi-terrestrial habit has developed to such an extent in some species, that they may be found living so high on the rocks that they get only the spray of water at high tide.

Planaxidae:

Planaxis is usually found in large numbers along with *Littorina*, and they are almost similar to each other in appearance, but on closer observations the differences can easily be recognised between the two. *Planaxis* shell has a shorter spire, wider aperture and no umbilicus. There is a distinct spiral ridge extending inwards from the inner side of the posterior canal, and the columella lip is broad.

Cerithiidae:

The shells have an elongated spire having many whorls marked with tubercles. The aperture of the shell is strongly channelled and the operculum is horny.

Cerithium is quite common in the backwaters along with *Cerithidea* (Potamididae), but they are few in number. It not only has the same habitat but also closely resembles *Cerithidea* in size and sculpture. *Cerithium* differs from it in being slightly more slender and having an additional ridge on the two lowest whorls.

Vermetidae:

Vermeteus has been collected in Kamat's Bay and Binge Bay. The whorls of the shell are not fused and it appears like a worm-tube. The shells are always attached to rocks. Their foot is reduced to a vestige, supporting only the horny operculum. Specimens of *Vermeteus* at Karwar, however, have their tubes coiled in one plane, unlike those described by Gravely (Madras).

Turritellidae;

Turritella shells are long, heavy and gradually tapering towards the apex with transpirally ribbed whorls. The foot is broad, truncated and provided with a horny operculum.

Turritella acutangula (Linnaeus) is the most common species found living at moderate depths in muddy sands. Both animals and empty shells have been collected in large numbers on the beaches. The largest specimen collected is about six inches in length. Sea-anemones (*Sagartia*) are sometimes found attached to empty shells buried in the sand.

Strombidae:

All Strombidae shells have a well-developed shell. The outer margin of the aperture has a tendency to grow into wing-like or finger-like expansions. Their foot is narrow, arched and adapted for leaping movements, and they bear a sharp claw-like operculum.

Strombus has a shell with the outer lip shaped like a wing. The rapid jerky movements of the clawed foot is dangerous to those who handle it carelessly. These animals live in shallow waters in muddy sands.

Rostellaria has a large shell with a long tapering spire which is finely polished. The outer lip expands into a wing and its anterior end is produced into a long and narrow beak. They are supposed to be found in abundance at depths between 10 to 30 fathoms. Only a few empty shells have been collected.

Hipponycidae:

Hipponyx has a bowl-shaped shell with three distinct ribs radiating from the apex. Several white shells have been collected from the shores of Anjidiv Island, Kamat's Bay and Karwar Bay. It is said that these animals live on the rocks of the West coast of Anjidiv island, which was not investigated.

Calyptraeidae:

Calyptraea (*Crucibulum*) *extinctorium* (Lamarck) is the common species of Karwar of which, many shells have been collected from several localities. The shell is thin and conical with a spiral apex, on the inside of which, can be seen a small curved ribbon-shaped plate. Living specimens attached to bivalve shells (*Paphia*) have been collected in the dredge in Karwar Bay.

Naticidae:

Naticidae are active sand-burrowing gastropods with a large foot whose outer parts are folded over the head, thus forming an efficient plough to burrow into the sand. Three genera are represented in Karwar.

Natica have thick shells with the body whorls bulged to such an extent that some forms look like *Pila* (Ampullariidae). The columella lip is more or less thickened. These animals are very common and are found in large numbers in the mud-flats of the estuary and backwaters. Their egg-masses are very peculiar and have been observed in large numbers. Thousands of minute eggs mixed with sand and sticky secretion, arranged to form soft spiral ribbons and standing out as little truncated cones, are common objects seen on muddy flats in Karwar.

Eunaticina have shells with a high spire and a straight columellar lip. Only a few dry shells have been collected on the shores.

Albula has a heavier shell with the body whorl oblique and less inflated. The umbilicus is completely closed by callus. A few worn-out shells have been collected.

Janthinidae:

Janthina is pelagic, living in the open sea. Their empty shells are often seen cast upon the beaches. The shell is thin and violet tinted, with no columella and umbilicus.

Cypraeidae:

Cowries have massive oval shells with an arched top and a flat base. The spire is not visible and the aperture is a toothed slit in the middle of the flat base. The foot is large without an operculum. The mantle, when expanded, can cover the shell and thus retain its polish. Several species of *Cypraea* are known in Karwar, of which *C. moneta* (Linnaeus) is quite common living on rocks between the tide marks. Their shells have a central elevation with yellowish colouration.

Cymatidae:

Cymatium is the only genus known in Karwar. The shell is thick with a well-developed spire and has uniform spiral grooves. The anterior canal is slightly elongated and the operculum is horny. A single specimen has been collected in Baitkal Cove,

Ficidae:

Ficus is represented in Karwar only by two or three empty shells collected on the shores. The shell is long, pear-shaped with a low spire and a large body whorl. The operculum is absent.

Bursidae:

Bursa granularis (Roding) is a common form found in the shallow waters of Baitkal Cove, Kamat's Bay and Karwar Bay. They live as scavengers feeding on the debris of muddy bottoms. The shell has a stout varix continuous along the whole length of either side. The remaining space of the shell surface is decorated with spiral lines of tubercles.

Potamididae:

The shells have elongated spires with numerous whorls either tuberculated or spirally ridged. The aperture of the shell has a short anterior canal and the operculum is horny. The following three genera are represented in the backwaters of Karwar: *Cerithidea*, *Telescopium* and *Terebralia*.

Cerithidea (*Potamides*) is probably the most abundant gastropod, found on the mud-banks of estuarine regions and back-waters. Their shells are small with each whorl ornamented by three transpiral ribs bearing tubercles. They have been observed in very large numbers in Chendie Creek and Kalinadi estuary. Among the specimens collected there are several species belonging to this genus.

Telescopium is easily recognised by its large shell (about four inches in length) and smooth whorls with faint ridges. A number of them have been collected on the mud-banks of the river Kalinadi.

Terebralia has also a large shell with broad spiral ridges and transpiral ribs, which are more or less distinct at least towards the apex. Only a few slightly worn-out shells have been collected from Mavin Halla area.

Eulimidae:

A single dry shell of *Eulima* has been collected in the Kamat's Bay. The shell is small, very slender with a tall spire and the whorls are not inflated. The surface of the shell is smooth and glossy.

Bullidae:

This family is represented only by the empty shells of *Bulla* which are usually washed ashore. It is a swollen oval shell, purplish-brown in colour. There is no spire and the aperture is broad in front and narrow behind.

Cavoliniidae:

These are small pelagic molluscs with two forms represented in Karwar. A few empty shells of *Cavolina* were found washed ashore in Kamat's Bay. The shells are thin, small, broad and pocket-shaped. The other form has a tubular shell, resembling *Creseis* in many respects. It has been observed in the plankton very often. Their foot is divided into two lateral fins. Many a time these tiny shells are also washed ashore.

Aplysiidae:

These animals are soft-bodied and lumpy, with a large foot. They possess a thin transparent shell covered by the mantle. Two representatives are found in abundance in Karwar.

Aplysia are dirty green in colour with brown spots and grey blotches all over the body. In Karwar, they have been collected in enormous numbers in Baitkal Cove, only during the months of December and January. They are found in muddy areas among the green seaweeds (*Ulva* sp.). Eggs of *Aplysia* are laid in long strings made of a jelly-like substance, and are found in masses of coils among the green seaweeds, in the same area and during the same season.

Bursatella (*Notarchus* Hornell) is smaller than *Aplysia* and the body is beset with small branched filaments. The shell is extremely small and internal. The lateral flaps of the foot are fused over the back posteriorly and not open like that of *Aplysia*. On the sides of the body are found some eye-like bright green spots with a brown ring. These animals have been collected in large numbers from the same locality as *Aplysia* and during the same season. They have also been collected in Mavin Halla area.

Dorididae:

A single specimen of *Doris* has been collected in Baitkal Cove. It is greenish-yellow in colour with dark tubercles all over the body. The gills are external and form a circlet round the anus.

Another nudibranch, which is probably included in this family, has been collected from the rocks in Kamat's Bay. It is a soft-bodied pink coloured animal living attached to rocks between tide marks (*Dendrodoris* ?).

Aeolididae:

A single specimen of *Aeolis* has been collected in Karwar, which was about an inch in length. It is a cream coloured, elongated, soft-bodied nudibranch with numerous cerata covering up the lateral aspect of the body.

Hervia, another nudibranch belonging to this family, is found on the rocks among sea-anemones and hydroids in Kamat's Bay. It is a beautiful pale pink-coloured animal about the same size as *Aeolis* and bears bright orange-coloured cerata, which are arranged in a series of tufts on either side of the body.

Arminidae :

Armina (*Pleurophyllidia* Meckel) was collected in large numbers on the Karwar beach only once (December 1945, at dusk on a full moon day). They were stranded on the shore by the action of the waves, where they remained motionless for a while and then burrowed into the sand. They have a soft flat body, oval in shape, and pale brown in colour with numerous white spots on the dorsal side. The, foot is long and bears rows of branchiae on either side.

Onchidiidae :

Onchidium, which is the sole representative of this family, is quite common in Karwar. It is a slug-like gastropod with a leathery skin bearing warts on the back. In addition to the eyes at the tip of the tentacles, many eyes are present on the warts. These animals are found in mud and on stones in the brackish water areas near the mouth of the river Kalinadi. A number of specimens have been collected.

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(*To be continued.*)

A NATURALIST IN THE NORTH-WEST HIMALAYA

BY

M. A. Wynter-Blyth

Part II

(*With two sketch maps and two plates*)

(*Continued from p.* 354 *of this volume*)

I

Manali

The valley of the Beas narrows at Manali, hemmed in by steep forested slopes. To the north it widens out into a boulder-strewn waste that extends to the foot of the great wall of mountains, ten miles away, which separates Kulu from the desolate high plateau of Lahoul. Down the valley, above where it bends to the east, are the big hills beyond Jagatsukh, and up the Manalsu Nala, which joins the main valley at Old Manali village, are views of the snow-covered peaks that are the source of the river Ravi.

The Kulu Valley, as Himalayan valleys go, is prosperous and much of its floor and lower slopes is closely terraced for the cultivation of rice and barley, and there are many orchards, for it is famous for its fruit especially those that are native to more northern climes. Other northern trees too do well, for the European oak, the linden (*Tilia europea*) and the Spanish chestnut flourish near Manali village.

Along the riverside grow tall alders (*Alnus* sp.) and the occasional poplar (*Populus ciliata*), while the lower slopes of the hills are covered with plantations of deodar (*Cedrus deodara*), and in the more open places with the scrubby growth that is usual at this altitude in the north-west Himalaya — — *Spiraea sorbifolia*, *Spiraea canescens*, *Berberis*, *Crataegus*, *Indigofera*, *Rhamnus*, *Cotoneaster*, roses and the holly-leaved oak (*Quercus dilatata*). Above the deodar plantations the forest is mostly of spruce (*Picea morinda*) with a scattering of horse chestnut (*Aesculus indicus*) and walnut trees (*Juglans regia*) and a thick undergrowth of ferns and mixed herbage of balsams (*Impatiens* sp.), dead nettle (*Lamium album*) and wild carrot (*Chaerophyllum villosum*), whose root is a favourite food of the black bear. Around 9,000 ft. it is common to find areas where planes (*Acer* sp.) grow to the exclusion of most other trees, and the vivid green of their young leaves makes a pleasing contrast to the sombre hues of the conifers. Above the spruce the dark-leaved Narkanda pine (*Abies pindrow*) becomes the predominant tree, to give place at 10,000 ft. to the mountain oak (*Quercus semecarpifolia*), where an abrupt transition to an alpine type of vegetation takes place. From 11,000 ft. forests of birch (*Betula utilis*) and shrubberies of rhododendrons (*Rhododendron campanulata*) stretch to the treeline at 12,000 ft.

* * * *

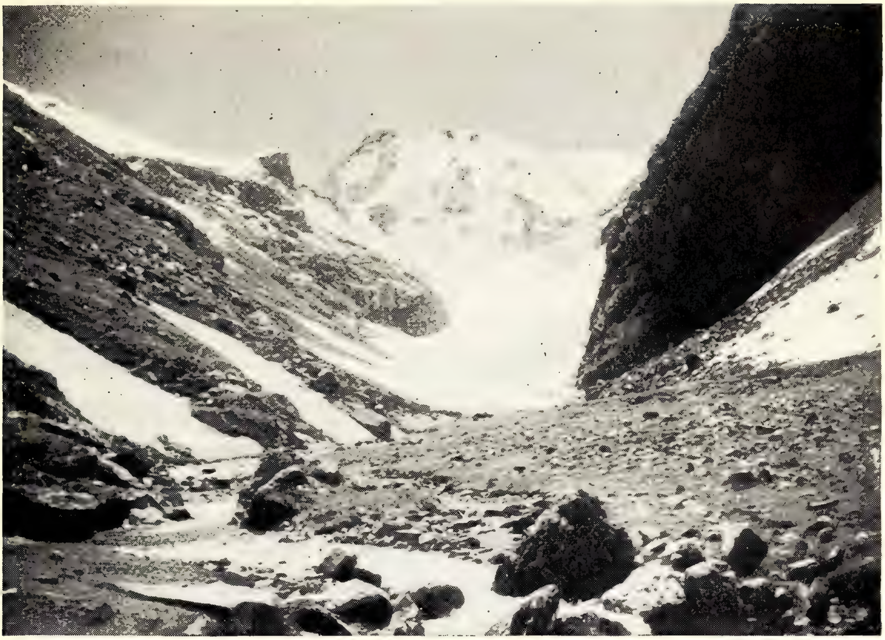
I had gone to Manali with great hopes of catching, if not any butterflies that were new to my collection, at least many that would be valuable additions to it. In this I was sorely disappointed for in spite of a profuse and varied vegetation I saw no more than 42 species in all, and apart from catching fine series of *Heliophorus oda*, *Heliophorus bakeri*, *Heliophorus androcles* and *Erebia shallada*, and one or two bedraggled comma butterflies (*Vanessa egea*), I collected no species that the most fertile imagination could describe as anything but very common.

However, my series of *H. oda* and *H. bakeri* were of interest. Although I do not possess the wet season forms of these butterflies in which the difference between them is greater, that between the spring forms is small; *bakeri* lacks discal lines and an orange-flushed area on the under forewing, characters which are present in *oda*. This, in conjunction with the facts that I found the two insects flying together and that some of them displayed characters intermediate between the two, leads me to suspect that *oda* and *bakeri* may merely be forms of the one butterfly and not distinct species.

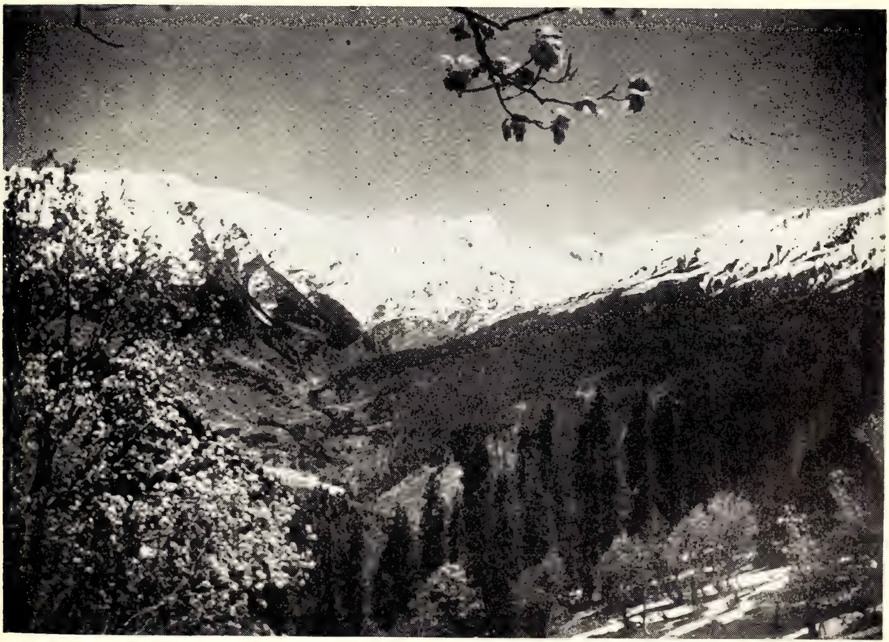
I was, however, more than compensated for my disappointment in Manali's butterfly life by the richness of the flora, which, though I am no botanist, I found to be of absorbing interest, especially that of the alpine region.

There was an easy route to the high altitudes up Khanpari Tibba, the mountain that rises abruptly just behind Manali. My first ascent was made in early May and took me no further than a steep little meadow at 9,000 ft. where spring had hardly begun and few flowers were yet to be seen except a scattering of white gypsophila (*Gypsophila cerastioides*) and strawberry blossoms (*Fragaria vesca*), purple thyme (*Thymus serpyllum*), golden *Ranunculus hirtellus* and the inevitable little blue gentian (*Gentiana argentea*). A week later I penetrated higher onto the extensive meadowland marked on the map as Gumhana Thach (*thach* being the vernacular for a grazing ground) behind the rocky steeps that mark the end of the first and hardest part of the ascent, to find that it was still under snow. At its lower edges among the trees *Primula denticulata* was in flower and among a fine display of the white racemes of valerian (*Valeriana wallichii*) were early growths of the strange *Trillium govanianum*, the three-leaved lily with a curiously spider-like yellow and purple flower, a close relation of the rare English herb paris.

My next ascent was at the end of May when the snow had receded from the lower parts of the meadow up to nearly 11,000 ft., but even yet flowers were scanty. *Primula denticulata* was now in full bloom, as was *Trillium govanianum*, a small purple fumitory (*Corydalis diphylla*) and the bright golden stars of *Gagea lutea* (the Star of Bethlehem). There were, too, some early anemones and a small, sweet-scented, leafless, flowering tree (*Viburnum foetens*). Where the snow had just melted, everywhere were visible the collapsed tunnels of Royle's vole (*Alticola roylei*). To judge from their abundance, the winters of these little animals are far from idle for they criss-crossed and wound about the surface of the ground much like the galleries constructed by certain species of white ant, but on a much larger scale. This vole scoops out a narrow channel along the surface of the earth and employs the earth so released for lining the upper part of the tunnel which is bored through the snow. Inside these, one imagines, the winter is spent



The Hamta Pass and Chhatoru, 18,344 ft.



Photos *Author*

View to the Rohtang Pass from Khanpari Tibba.

Photos

The Hamta Nala.

Author

Ibex country—Hamta Nala.

scuttling to and fro feeding on the roots, seeds and grasses come across during the excavations.

I trudged through the snow to the top of the ridge leading to the final slopes of Khanpari Tibba, where I sat down and ate my lunch. The view was superb for I was encircled by snowy peaks. To the north it almost seemed as if I looked down onto the Rohtang Pass (13,050 ft.), ten and a half miles away, where the track of early travellers to Lahoul could be marked in the snow as a thin black line winding across the long gentle ascent of its summit. To the east was the great mass of ice-capped Dev Tibba (19,687 ft.) and, close beside it, the magnificent precipices and ice-falls of his greater, though nameless, brother. Again to the left was the pillar-shaped peak behind Chhatoru and the approaches of the Hamta Pass, and a little nearer the vast chimney of Indar Kila standing like a huge obelisk on the mountainside.

After lunch I began to return at a run down the steep snow slope that I had so carefully ascended. I soon learnt that this was a mistake for the snow was harder and more slippery than I had realised and before I could prevent it I was embarked on an involuntary glissade travelling at ever-increasing speed. Almost from the first I knew that I should inevitably collide with the trunk of a birch tree some 50 yards down the slope, and I remember turning over in my mind in an entirely detached way what would happen to me if I broke an arm or leg in this remote spot. The next I knew was that I had left the ground where the incline suddenly grew steeper and was flying, first through the air, and then through a rhododendron bush, which, I suppose, slowed me down somewhat, to glance violently off the birch tree and come to rest six feet lower down up to my waist in snow. I picked myself up with care and was surprised to find myself intact except for a few minor bruises and scratches. Thereafter I proceeded with great caution.

My final ascent was made on June 9th, the season when the cherries are ripe in the Manali orchards and the forest is lovely with the lilac of irises (*I. nepalensis*?). Beyond the old village the rare tiger-lily (*Hemerocallis fulva*), a favourite garden plant, blooms among the rocks, and the lily of the valley (*Ophiopogon intermedius*) and the little dark blue and white *Mazus rugosus* flowers on the shady banks. Among the long grass can be found the curious climbing lily, *Polygonatum cirrifolium*, with the tendril-like leaf tips and drooping white flowers, and in the hedgerows the brilliant blue vetch, *Parochetus communis*.

But in case it should be thought that all the flowers at Manali are things of beauty it must be mentioned that this is also the season of the inflorescence of that most unpleasing of plants, *Sauromatum guttatum* of the Araceae. Imagine a leafless growth with an erect, narrow column, or spadix, prolonged into a long, tapering, dark-purple appendage, surrounded at its lower end by a sheath, or spathe, of a sickly yellow hue, heavily blotched and spotted with purple, whose upper part is open, bent back and spreading. Imagine, too, that this loathsome object fouls the air for yards around with a most disgusting odour, and then the reader will have a fair impression of the plant.

Two hours saw me at the foot of the meadowland where a pleasing sight met my eyes, for it had become a garden wherein flowered a profusion of white and blue anemones (*A. obtusiloba*), golden *Ranunculus hirtellus*, *Trillium govanianum*, and nodding heads of purple-chequered fritillaries (*Fritillaria roylei*).

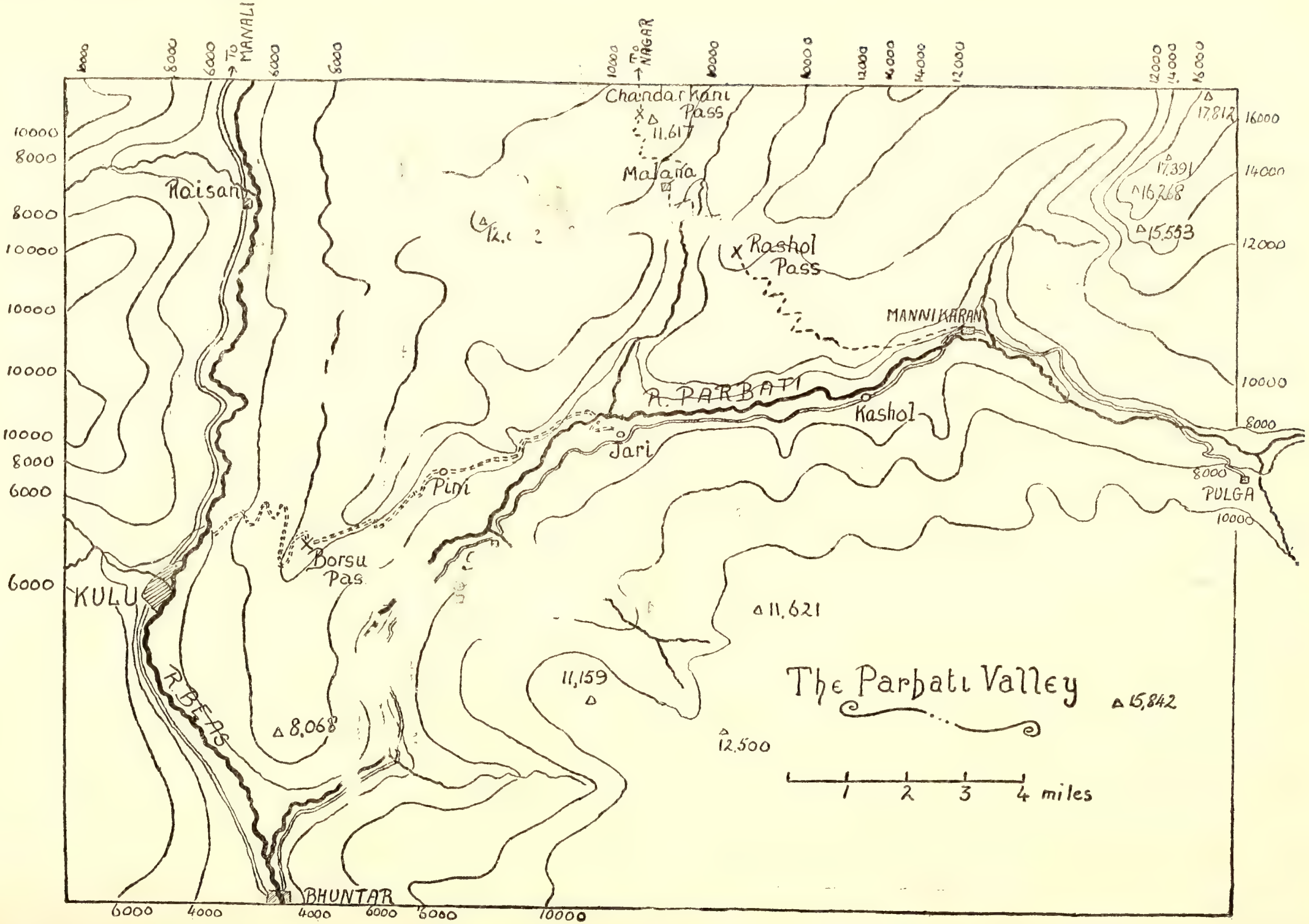
On entering the meadow I startled a monal into flight, loudly shrilling his ringing alarm whistle, to be followed a moment later, as is their custom, by his drably-coloured mate. This bird is common at this season around 10,000 ft. and to have seen him in flight from above with the sun shining onto his plumage is to have witnessed one of the most lovely sights in nature. His head and crest of spatulate feathers, are of brilliant metallic green, and around his eyes is a bare patch of bright blue flesh. His nape is of flame-tinted bronze which shades into the silky green of his upper back. His lower back and wing coverts are of silky purple, and his tail bright cinnamon, the only drably-coloured parts of him being his dusty white rump and dusky black breast and legs, a contrast that has caused the following legend about him to grow up among the hill folk.

In the beginning Jija Rana, the bird god, created the monal king of the pheasants, giving him the plumage he deemed worthy of this position. But that bird, being displeased with his drably-coloured breast and legs, complained to the god and asked him to improve on his handiwork. However, Jija, being extremely annoyed at such criticism, angrily drove him off, speeding him on his way with a handful of ashes picked from the fire, which fell on the lower part of his back so that from that day to this the monal has had a dusty white rump. Jija Rana then set about the creation of an even more beautiful bird to take the place of the monal as the pheasant king, and so came into being the glorious, scarlet, white-spotted, black-breasted tragopan, who ever since has been called Jija Rana in honour of his maker.

I walked across the meadows to where the final steep pull-up to Khanpari Tibba begins among shrubberies of mauve rhododendrons (*R. campanulatum*), as yet hardly in flower, for the season is late on these northern slopes. Marsh marigolds (*Caltha palustris*) were growing in profusion among the rocks and there were the bright yellow spikes of a fumitory (*Corydalis govaniana*). At 12,000 ft. I passed through the shrubberies and onto grassland above the treeline. Here on a meadow favoured by the sun the bright blue, golden, cream-coloured and white forms of *Anemone obtusiloba* were massed among the deep purple of dwarf irises (*Iris milesii* ?), white garlic (*Allium govanianum*), yellow *Ranunculus* and lilac *Primula denticulata* to form such a carpet of flowers as I had never seen before.

On my return I was caught in the most violent hailstorm that it has been my lot to experience, and had I not been able to shelter under a large rock I should have been in a sorry plight for the hailstones were of the size of marbles. It wrought great havoc in this natural garden, beating down and destroying the flowers, except the nodding heads of the fritillaries which seemed especially constructed to withstand such an onslaught.

Lower down in the forest I saw a pine marten (*Charronia flavigula*), which, it so happened, was except for monkeys, the largest wild animal I saw in Kulu. His markings were unusual and striking, for his head appeared to be black down to the line of his eyes, as were his bushy tail, legs and hindquarters, whilst his back was brownish-grey. There is also another marten to be found here, the stone marten (*Martes foina*), but he is seldom seen, being very nocturnal in his habits. Of the other wild animals that I might have seen, black bears (*Selenarctos thibetanus*) are undoubtedly common, especially on this Khanpari Tibba


The Parbati Valley
To MANALI
To NAGAR
Chandarkani Pass
11,617
Malana
Rashol Pass
MANNIKARAN
R. PARBATI
Kashol
Jari
Pini
Borsu Pas
Raisan
KULU
R. BEAS
BHUNTAR
PULGA
17,812
17,391
16,268
15,553
15,842
11,621
11,159
12,500
8,068
0 1 2 3 4 miles
6000
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16000
4000

Sketch Map 1

where I came across many of their scratchings, but they are abroad little in the daytime and are adept at keeping out of sight. At this season brown bear (*Ursus arctos*) are up at the high altitudes, but I saw the tracks of one that had crossed over the Hamta Pass. The snow leopard (*Uncia uncia*), too, had moved to the heights, but one had been shot close to Manali village as late as April, after having killed a pony and mauled a bull terrier dog, and another was seen in Lahoul, a march or so beyond the Rohtang Pass in early June. Ibex (*Capra siberica*) do not seem to be rare as there were several reports of them whilst I was in the valley, and bharal (*Pseudois nahoor*) to judge from the number of their horns that decorate the local temples, are to be found not uncommonly. The antlers of barasingha (*Cervus hanglu*) are also a popular decoration but these must be imported. (Rannoo, who is usually a reliable informant and is the generally accepted authority on wild life in Manali, asserts that they come from western Kangra, but no textbook allows that they can be found nearer than Kashmir). Of the rest, musk deer (*Moschus moschiferus*) are not very rare, and are persecuted for their musk pouch, tahr (*Hemitragus jemlahicus*) are present on the craggy hillsides, goral (*Nemorhaedus goral*) in the same type of country at lower altitudes, and serow (*Capricornis sumatraensis*), here called *yamu*, which are scarce, can sometimes be found in remote and thickly wooded nalas. I am told, too, that there are leopards, and that wolves occasionally come over from Lahoul in the winter.

II

THE PARBATI VALLEY

Edward Peck's plan was to walk from Kulu to Narkanda over the Pin Parbati and Bhabeh Passes. I agreed to accompany him as far as Pulga where he hoped to hire coolies to take him over the mountains to Wangtu.

Our drive down to [illegible] early on the morning of June 1st coincided with the annual influx of flocks from Kangra, and progress was much delayed by the many thousands of sheep and goats on their way up to their summer pastures in Lahoul. Although at times it seemed as if we should never reach our destination it was an interesting spectacle. Many of the animals carried little packs for it is necessary for the herdsmen to take all their provisions into the desolate regions where they will spend the summer, and every herd was accompanied by one or two big dogs, whose function is quite different from that of sheepdogs in most countries, for they are kept solely as a protection against wild animals. The herdsmen are picturesque in their grey, rather tall cloth hats, and large grey coats, or kirtles, secured round the waist by yards of twisted cloth so that the lower part of the coat, which ends well above the bare knees, projects outwards a little all around and gives the wearers a vaguely Grecian appearance. Their journey to Lahoul is slow, for they halt on the side pastures on their way up the valley.

The twenty-three miles took us two and a half hours and on arrival we found Rannoo waiting for us at the bridge with the transport and the pony man.

The start, at 9-45 a.m., was exasperating, for after three quarters of an hour we had covered a mere quarter mile and ascended but two hundred feet. This was mostly the fault of the pony man for he had tried to lead us up a boulder-strewn slope by a path that existed only in his imagination, but in addition there had been difficulties with two of the ponies. The ropes securing the burden of one had twice broken, and the other, in a fit of irritation, had cast his down the hillside. The third animal, a minute mule, whom, in spite of his sex, we nicknamed Jenny under the mistaken notion that such an animal is called a jennet, had given no trouble. This was reserved for the fourth day when I was on my own.

After this Rannoo took the ponywallah in hand and our progress along the very winding path up the mountainside was more rapid, but we did not reach the Borsu Pass, if this tedious way over the long shoulder dividing the Parbati from the Beas can be honoured by such a title, until half past four. The weather had by that time deteriorated and several thunderstorms were converging overhead. As we crossed the pass, the storm broke, conditions being made much worse by the fact that we were now on the windward side of the hill.

The next three hours were among the most uncomfortable I can remember. The road, to use an euphemism for the narrow ledge scratched out of the hillside, endlessly traversed across crags or grassy slopes that must have been set at the steepest angle at which the growth of grass is possible. Every now and then when it had crossed a spur projecting into the valley, it would zig-zag down its tree-covered northern side for a little before continuing its traverse. The track was in a deplorable condition and in one place where it was blocked by fallen trees it was necessary to unload the baggage and lead the animals some way down the hill by a very slippery detour, and in another a landslide had left a yard-wide gap where the only foothold was a ledge six inches wide. A slip would have precipitated a pony on a journey that would have ended only in the Parbati, five thousand feet below. I shut my eyes and turned the other way while Rannoo literally heaved the animals across.

There were pretty flowers to be seen beside the path, banks of thyme (*Thymus serpyllum*) and gypsophila (*G. cerastioides*), and massed grey-blue and purple salvias (*S. moorcroftiana* and *S. lanata*), and a white gerbera (*G. lanuginosa*) was growing in the interstices of the rocks, but I was far too wet and miserable to pay these anything more than the most perfunctory attention, so that it was with the greatest relief that at last, just as dusk was falling, we descended to the first village we came across to pitch camp close to a temple under the shelter of some deodars.

That the village should be called Pini was ironical for the only water we could obtain was a muddy fluid from a small pond, but otherwise Rannoo soon had its inhabitants organised and the tents were up and a meal cooked in a very short time.

Here perhaps Rannoo Shikari should be introduced for he is a character worthy of it. He is a man of most commanding presence and forceful character, and, as he is most capable and knows all there is to be known about the Kulu Hills and their game, those who employ him are fortunate, even though, as is often the case, they may hold him in considerable awe. It must be added that he seldom misses with either shotgun or rifle, is a competent cook and is quite tireless. This paragon is a realist and takes a poor view of his fellow creatures, especially low in his opinion being the dwellers on the plains of India, to whom he refers as 'Hindustani lōg' and the 'bazari lōg' or those who live in towns. As he also condemns most hillmen as 'badmash lōg' it will be obvious that the persons who come up to the high standards necessary for his approval are few indeed.

The tents proved to be waterproof and, lulled to sleep by the sound of raindrops falling on the canvas, we passed a good night. I, however, was rudely awakened by the collapse of my tent at 6.00 a.m. and on disentangling myself from its folds had my first daylight view of our camping site. Under better conditions it would have been idyllic, for facing us across the valley was a magnificent view of the array of crags and peaks surrounding Shāt Nala, gloomy and sombre under the lowering storm clouds and wreathed with banks of mist. Just below us were the roofs of the little village and fields of ripe barley, now beaten down by the rain, while close above us in the cedar grove stood the temple, a wooden building with a peaked slate roof and overhanging eaves. As is customary its entrance was decorated with the horns of wild animals and, a novel feature, with carvings representing elephants, camels and what appeared to be dancing girls.

The rain eased off sufficiently for us to breakfast in comfort but came on again heavily when we resumed our march, so that we were very soon just as wet as we had been the evening before. At last, after again traversing bare hillsides and cliffs, we descended to the river, whose milky waters were in furious spate, crossed it by the Jari bridge and climbed to the forest bungalow where we rested and brewed for ourselves some tea.

As soon as we continued on our way to Mannikaran, nine miles off, the rain began to slacken and presently stopped altogether, allowing us at last a view of the beauties of the Parbati Valley, for it is very lovely.

It is a narrow V-shaped valley with the sides rising steeply for some six or seven thousand feet those to the north, as usual, being rather bare above their lower slopes, with magnificent precipices, but those to the south are finely wooded, as is the bed of the valley where the road runs through plantations of deodar and *Pinus longifolia.* Up the valley, and to its two sides, are views of snow peaks, those above Mannikaran being topped with strange pillar-like projections of rock, a common phenomenon in the north-west Himalaya. Opposite to Jari opens the forbidding Malana Gorge, the only winter entrance to the strange Malana Valley.

Nevertheless Mannikaran, and that part of the valley that contains it, has no pretensions to beauty, for it is a squalid collection of dilapidated houses set among bare, unattractive hillsides where the river bends to the east. It is, notwithstanding, a remarkable place, for, as the pillar of steam hanging in the dank and humid air declared even before the town itself came into view, it is the home of a veritable congeries of hot springs, and as such is a place of some importance for pilgrimages, both for spiritual and bodily welfare. As well as the principal bathing place near the little temple close to the river, there are numerous springs by the waterside and others in the village itself, the water gushing out of the ground and running along the village streets, so that it may literally be said that Mannikaran is a place with hot (but no cold) water laid on. The truth of this statement we learnt later when we discovered that among this plentitude of hot water the only drinking water was that obtained from the river, a completely opaque fluid the colour of dirty milk, and, in fact, a thick emulsion of glacier-powdered rock ! However, the greatest use is made of the *hot* water, for as well as supplying the villagers with ever-ready hot baths it is also freely employed for cooking. The priest, who exercises a monopoly over the latter, because the temple precincts contain the best and hottest spring, has, he told us, a regular schedule—half an hour for rice, one hour for dhal, and so on. All the time we could see dishes of hot food being fetched away from the temple.

As a rest house is marked here on the map we had hoped to spend the night in relative comfort and to be able to dry our drenched clothes and damp bedding. But we were disappointed because the rest house had been turned into a school, and so we had to fall back on the local 'hotel' kept by the village shopkeeper. This is an unprepossessing building, very like a row of poor stables with a verandah in front. We had already peered into the two end rooms which lay open, and not much approved of what we had seen, when the shopkeeper arrived bearing a large bunch of keys, and led us carefully round to the back, unlocked several doors and with a grand flourish ushered us into the best suite, the two open rooms we had already inspected. It was a fine piece of showmanship, but unnecessary as there was nowhere else to stay and we were too tired to search for a camping ground.

If the building had been unprepossessing outside, it was more so inside, being in a state of considerable disrepair and very dirty.

A great circular red patch where the plaster had fallen off the wall gave us both an uneasy feeling that this room had been the scene of some sinister Mannikarian crime of violence, and Edward Peck (possibly because he has travelled much in Turkey) also viewed the two string charpoys with some degree of suspicion—a suspicion that I tried to allay by telling him that I had seldom been bitten by bed bugs in India. Although, as it turned out, I proved to be right, he was not further reassured when we retired for the night by the sight of a large scorpion climbing up the wall.

Almost as soon as we had left Mannikaran the valley resumed its pleasant appearance, and by mid-day we had climbed to the rest house at Pulga. Here bad news awaited Edward Peck for we learnt that the Pin Parbati Pass would not be open to coolies for another six weeks, so there was nothing to be done except to return to Manali. Pulga, however, was well worth the trip for its own sake, for it is a place of great beauty. The rest house looks across the valley up Tos Nala, by way of which is a difficult route to Spiti, framed on the one side by the high mountains above Malana and on the other by the magnificent peak of Dharingdhar (19,000 ft.). Further up the valley, and partly behind Dharingdhar, lies another peak of almost identical shape and size, whilst behind and to the right of the bungalow above the forested slopes were the icefalls and glaciers of Baskihag shining with new fallen snow.

Life in this valley is hard and it must be a difficult task for its natives to wrest a livelihood from their scanty fields. Perhaps this poverty may partly account for the fact that at least 70% of the adult population of the valley above Mannikaran suffer from goitre, any person above the age of twenty-five who does not show signs of it being a rarity indeed. It is a common enough infirmity throughout the north-west Himalaya, but nowhere have I seen more sufferers from it than as in this neighbourhood.

We spent that night on the rest house verandah, as we had been politely but firmly told by the chowkidar that we could not be allowed to enter the bungalow without a pass. Nevertheless we greatly preferred this sleeping place to that of the previous night, although a bitter breeze was blowing from the snows.

The next day we returned to Mannikaran where Edward Peck suddenly decided to return to Manali by way of Malana and the Rashol and Chandarkani Passes. As the thought of carrying my bedding and belongings up 6,000 ft. of extremely steep hillside did not appeal to me (for no coolies could be obtained) I decided not to accompany him and Rannoo, but to continue down the valley with the transport.

Malana, because it is so isolated and cut off from the outer world, has earned for itself a considerable reputation. The inhabitants speak a language of their own, a dialect of the Tibetan group that is unintelligible to the natives of the adjoining valleys, and have managed to maintain a marked degree of independence (which is carefully fostered by Jamloo, who lives on Dev Tibba, through his earthly representative, the headman of Malana). If local reports are to be trusted the Malanese have persistently refused to pay taxes and are very hostile to strangers.

Peck and Rannoo camped that night at Rashol and the following day passed through Malana and over the Chandarkani Pass down to Nagar, a remarkably long march. Their journey was uneventful and they were unmolested by the Malanese. Indeed the only living thing they saw in the village was an ancient woman who fled into the forest on their approach.

I, however, had a trying afternoon now that Rannoo was no longer with us to control the ponies. The black pony, having friskily kicked to pieces the wooden gutter carrying the water supply to Kasol rest house, indulged herself in barging matches with Jenny, who himself became more lively the further we went, breaking every now and then into a brisk trot to the great detriment of his load. All the while the brown pony lagged behind having to be driven every inch of the way by the ponywallah.

At 6·00 a long day come to an end at last and we pitched camp underneath some alders beside the river in Shāt Nala. The ponywallah made himself useful (indeed! it was time) and insisted on brewing my tea and boiling the eggs. The same method served for both (in fact it would have saved time if they had been done simultaneously in the same degchi) for they were placed in cold water and when that came to the boil they were ready. Strangely enough, and a useful fact to remember, the results were remarkably successful.

I set off at 6·00 on the morrow in order to reach Bhuntar by 9·00 when the Kulu bus was reputed to pass through the village, but no matter how fast I travelled I found myself unable to exceed three miles an hour, even though every now and then I broke into a rapid amble. I regretfully put down this fact to advancing age. Having reached Bhuntar and found no bus, I continued toward Kulu in the hope that the bus would overtake me—which it did, but not before I was one hundred yards from my destination. Now the strange thing was that

I had covered the six miles from Bhuntar to Kulu in exactly 1½ hours although I had decreased my pace considerably. Would it be unworth, to suspect that the milestones on the Parbati road were so placed to the considerable profit of the contractor who built it ?

III

THE HAMTA PASS

The route from Kulu to Spiti crosses the Pir Panjal Range by the Hamta Pass, which, though relatively low (14,025 ft.), possesses a rugged grandeur that can be surpassed in few parts of the Himalayas. The pass is 21 miles from Manali, but three days are needed for the return journey.

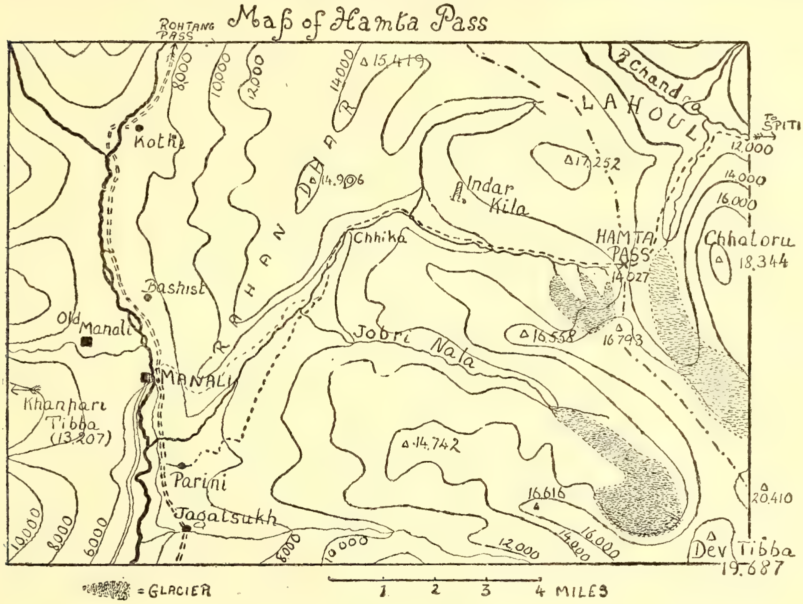
Three of us set out from Manali on the morning of June 18th with five coolies and the redoubtable Rannoo. Our way ran along the short-cut over Rahan Dhar, the forested ridge that separates the valley of the Beas from the Hamta Nala. The coolies were heavily laden and found the going hard, but, as luck would have it, Rannoo met two friends on the mountainside whom he forthwith impressed into our service. This entailed a wait while they returned to the village to collect food for the journey, and when at last they reappeared, to our surprise they were accompanied by a large he-goat. It turned out, however, that this was not an auxiliary to our transport, but that they were going to leave him with a friend herding goats along the route.

The day was hot and sunny as we steadily climbed among the pine trees. In many places the undergrowth was a lilac mist of flowering irises and the air was often fragrant with the sweet scent of syringa. Every now and then the pleasing song of a rock thrush (*Monticola rufiventris*) could be heard from lower down the valley and occasionally, too, we were startled by the hurried, chattering call of the small cuckoo (*Cuculus poliocephalus*) from a nearby tree. Above us three hobbies (*Falco subbuteo* ?) stooped and wheeled and screamed in their incredibly rapid and swift-like flight as they mobbed an eagle.

But it was mid-day before we had passed over the ridge, for coolies, even when they are cheerful and willing as these were, are a slow means of transport. Our way then lay up the Hamta Nala, at first high above the river, across steep slopes and the lower crags of the stupendous precipices that wall the valley on its western side and continue almost unbroken to beyond Chhika. From the other side of the nala this track looks most dangerous, but it is by no means as bad as it looks, and is in fact of no difficulty to the reasonably sure of foot and steady of nerve.

On a small pasture where our path descended close to the river we met two shepherds herding their flocks, who told us that they had seen two black bears early that morning and wished us to camp there to shoot them. However, time would not allow of this, and so we pressed on.

Again we climbed high above the river, to descend once more to the river bank opposite to the entry of Jobri Nala from the east, across a meadow that was a golden lake of marsh marigolds, into a small grove of mountain oaks. Here was supposed to be the bridge that would take us across the river, for further progress up its western bank was impossible as the cliffs dropped sheer to its waters. As the whole advantage of taking the short-cut across Rahan Dhar depended on the existence of this bridge I had made careful enquiries before setting out, not only of its presence but also of its nature, for the hillmen, who can balance with the agility of cats, frequently span a river with two slender tree trunks set a foot or two apart, over which they pass with complete unconcern, no matter how high they are above the water, nor how turbulent is the torrent beneath. Rannoo, however, had assured me that there was a very good bridge. At least, as he qualified it on second thoughts, one over which goats could pass.



Sketch Map 2

But the bridge, swept away by the first spate of the melting snow waters, was no longer there ! Rannoo, never to be nonplussed, announced that he would build a bridge—the coolies carried an axe—but this proved to be unnecessary, for just then we made a discovery that realised my worst apprehensions. A tree had fallen across the stream, half spanning it, to collect a flotsam of brushwood at its nearer end, over which it was possible to scramble to the middle of the river where precarious access to the slippery trunk could be gained.

Rannoo, performing marvels of agility, successfully piloted each of us to the other bank, shaken but unscathed. Once over we proceeded up the main Spiti track where the going was good, to arrive at 6-30 at the camping ground of Chhika—a few flat boulder-strewn acres in a huge amphitheatre. Vast crags hemmed us in to the north and west, and above us the river descended through a gorge, between the sides of which could be seen the gigantic pillar of Indar Kila, a great finger of rock two hundred feet in height, standing in isolation on the snowy mountain side, whilst on the steep hill slopes to the east were shrubberies of mauve-flowering rhododendrons and scanty birch forest.

The vegetation round about was rank and lush, mainly of a coarse grass and a tall, many jointed dock (*Polygonum* sp.) among which, in those parts that had not been grazed by the flocks pastured there, was an abundance of the curious three-leaved *Arisaema intermedium* with the striped spathe that is so like the spread hood of a cobra, and many other flowers—by the water yellow marsh marigolds, light blue *Cardamine macrophylla* and wood forget-me-nots (*Myosotis sylvatica*), whilst here and there were bright yellow violas (*Viola biflora*), dwarf purple iris (*Iris milesii* ?), a long-stemmed deep blue primula (*Primula involucrata*), and on the grassy banks the little blue *Veronica serpyllifolia*, white *Thlaspe alpestre*, and pale purple *Androsace sarmentosa*.

A bitter wind was blowing, and when darkness fell we huddled over the camp fire and sought the protection of our tents as soon as we had eaten.

We awoke soon after dawn to the chak ! chak ! of a flock of alpine choughs (*Pyrrhocorax graculus*) as they wheeled about in the air above us or grubbed for worms on the slopes nearby. At half past seven we set out for the pass, telling Rannoo we should return before half past four. Rannoo, who is the embodiment of tact, regarded us with doubt but refrained from comment and himself set off with my rifle to search for ibex on the crags, for he said that those to the north and west of us were known to harbour three fine heads.

Two miles'-scramble up the road, which had now degenerated into a wickedly rough track, took us through the gorge and past two large snow bridges spanning the river, to a place where the valley widened and turned sharply to the east, revealing a view that was grand, but forbidding in the extreme. High crags fell sharply from the snow-capped peaks that now walled in the right-hand side of the valley and poured down screes on which grew the last of the rhododendrons, whilst to the left its sides sloped more gently to the snowfields of Indar Kila. Straight ahead the pointed finger of rock surmounting the peak (19,834 ft.) beyond Chhatoru was just visible, but as yet the approach to the pass could not be seen, being concealed by a bend in the valley a little way ahead.

Amongst the boulders and on the grassy slopes from which the snow had recently melted were a multitude of flowers. That finest of anemones, *Anemone obtusiloba*, grew everywhere, flowering in its brilliant blue, white, gold, and cream-coloured forms. Equally abundant were the marsh marigolds, becoming ever smaller with the higher altitude, and the bright pink, yellow-centred, *Primula rosea*. Here and there was a dark blue spike of *Corydalis cachemiriana*, and once we had the good fortune to find the large and lovely *Primula macrophylla*, which has blossoms of the deepest purple, growing solitary upon a rock.

Snow pigeons (*Columba leuconota*) were common, flying in flocks like the blue rock, or perching singly and in pairs on the tops of boulders as they are fond of doing. Because they are shy birds and fly extremely fast I was not surprised when I failed to shoot any for the pot. We had also hoped to see that fine bird, the snowcock (*Tetrogallus himalayensis*), a giant grey, black, white and chestnut game bird, but luck once more was against us and none was about.

After climbing for another two miles the valley bent slightly to the left to disclose a clear view of the immediate approaches to the pass, the pass itself not being visible until the climber is almost upon it, because it is placed behind the shoulder on the northern side of the col at the head of the valley. The snowfields began close ahead of us and sloped gently until at two and a half miles the ascent became steep, a climb that I foresaw might be difficult. The huge bulk of Chhatoru (18,344 ft.) stood as a background to the pass and towered over it.

One hour's steady ploughing through the snow brought us to the lower slopes of the steep final ascent and as we rested and ate our lunch we congratulated ourselves that another half hour would see us on the top. We were wrong. There were nearly two hours of stiff climbing ahead of us.

When first we saw this slope from a distance we had observed a sinuous black line winding down it past the rock on which we were now sitting, and had assumed it to be the median moraine of a glacier. But here we could see that this was not the case, for it turned out to be a line of mud and stones thrust up through the snow by the Hamta stream. What is the cause of this phenomenon I do not know, never having seen nor heard of it before.

Just before the head of the valley, on its southern slope, hangs a small glacier, the tongue of a larger glacier that covers the mountain higher up. In days gone by this glacier pushed its terminal moraine right across the valley to its farther side, and it was between this and its northern crags that our way seemed to lie. So far there were no tracks for us to follow and it appeared that we were the first to cross the pass this year, but shortly after leaving our luncheon place we found that another being had made the journey recently, for there in front of us stretched a line of tracks leading down from the pass. Although the footprints were man-like it was obvious from their size and the distance between each of them that they had been made by someone of more than human dimensions. In short, it was clear that they were the tracks of an Abominable Snowman, that superhuman giant of evil repute that inhabits the high regions of the Himalayas.

We soon discovered that the Snowman knew exactly the right route over the pass, for as long as we followed him we avoided difficulties, but once we deviated from his trail we found ourselves in trouble. This was when we struck out on our own course to climb behind the moraine at its nearer end, to find that to gain its crest we had to make a precarious traverse across a steep slope of hard and slippery snow. As we kicked steps I eyed the black rocks at its foot with apprehension, remembering my involuntary glissade on Khanpari Tibba some days before. The Snowman, however, had made a direct assault on the middle of the moraine which, on our return, we found to be a much more practicable route. Having struggled to the top of the moraine and made our way along it, another steep ascent lay before us, up which the going was exhausting as there was a layer of soft new snow into which we sank at every step.

Here I must record my self-satisfaction on finding that the altitude was affecting me much less than my two companions, who seemed very tired, and, who, truth compels me to relate, were suffering from high altitude irritability. So, my encouraging words falling on deaf ears, I went on ahead, and having covered the final hundred yards of nearly level snowfield, stood at last upon the pass. The time was 2-30 p.m.

The Hamta Pass crosses into the Chhatoru Nala some three miles below where the latter ends at the foot of the icefalls and tremendous precipices of the huge nameless peak (20, 410 ft.) which can be seen directly to the right of the pass, over the snow slopes of the col on which we stood. Straight in front, on the other side of the glacier-filled Chhatoru Nala, towered Chhatoru, down whose sides avalanches thundered almost without cessation, for the day had been warm and sunny. To the left of this mountain the precipitous wall of the nala swept down from a bewildering array of sharp peaks until its lower reaches were concealed from sight by the rocky ridge close to our left. The view back to Kulu was obscured by the snow slope around which we had come, but by retracing our steps for a short way we could look down the Hamta Nala and over the crags above Chhika to the high dome of Shikar Beh (20,340 ft.), twenty miles away.

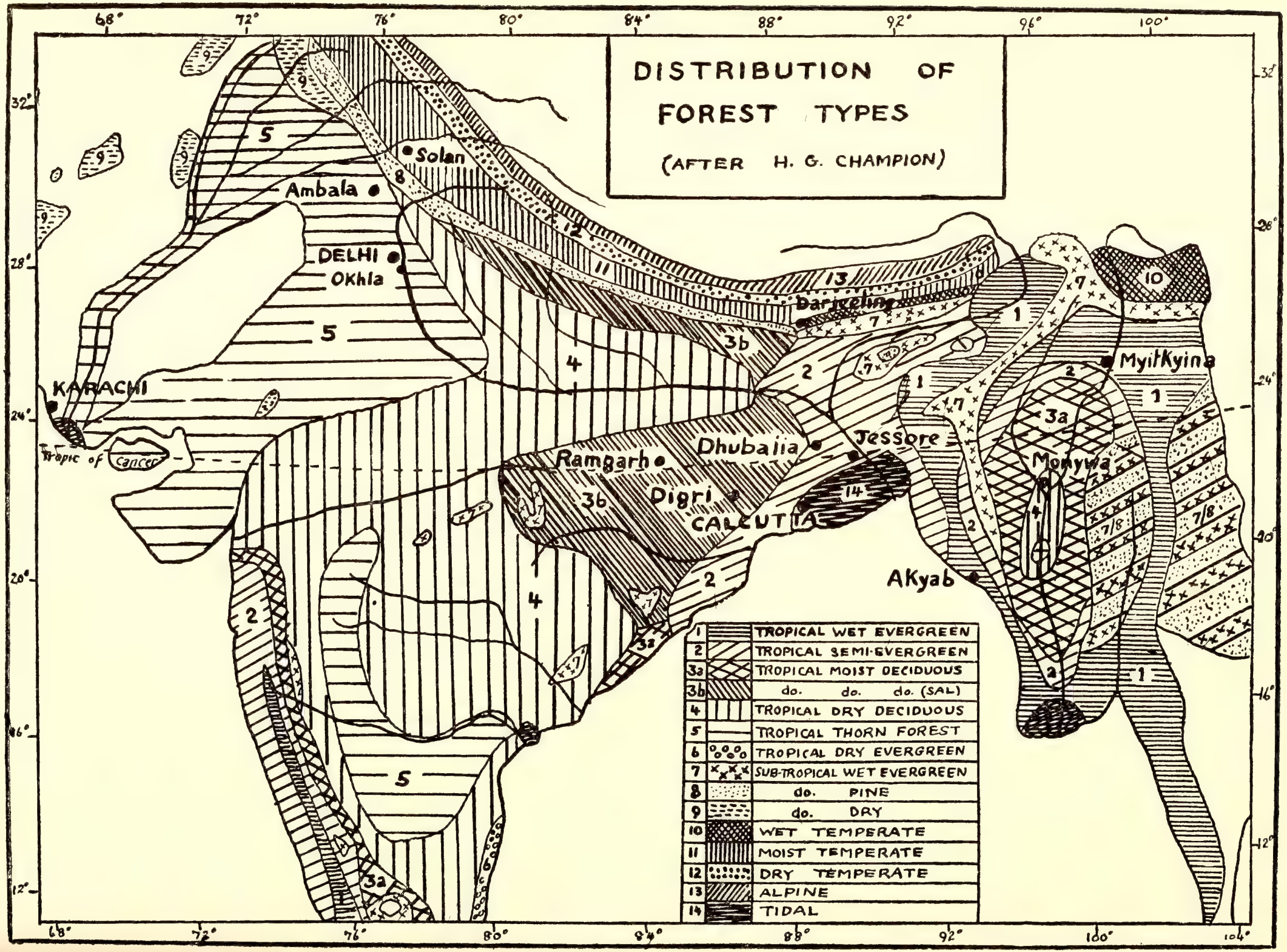
After basking in the sunshine for an hour—strangely enough the pass itself was warm, although in the valley we had been chilled to the marrow by a bitter wind—we returned, running down the snow slopes and glissading gently down the face of the moraine, for the sun had now softened the surface of the snow. The sun, too, had removed the obscuring traces of the previous night's frost from the footprints of the Abominable Snowman, revealing in one particular instance a clear imprint of long claws that could only have been made by a bear. So, after all, as I suppose is always the case, our Abominable Snowman turned out to be a brown bear. The truth of the matter is that these bears place their hind feet onto their front footmarks, and the action of the wind, the frost and the sun soon obscures the marks so that it cannot be seen that one paw has been placed upon another, with the result that the final effect is very like the track of some gigantic man.

The placing of the hind foot onto the front footmark is done with the utmost regularity, and not in a single instance did the tracks of this bear look like anything other than those of a biped!

Sped on our way by a snowstorm, we arrived in camp at 6-00 p.m. to find that Rannoo had returned empty-handed. He had seen ibex, but no shootable heads.

The following morning we returned to Manali by the main route through Parini, avoiding the short-cut and the perilous bridge. Rannoo left us at Jobri to ascend the nala to shoot me a monal—for scientific purposes let me hasten to add, though it served for another purpose as well!

N. B.—My small collection of plants from Kulu was very kindly identified by Rev. Fr. Santapau of St. Xavier's College, Bombay, & Mr. M. B. Raizada of the Forest Research Institute, Dehra Dun.



DISTRIBUTION OF FOREST TYPES

(AFTER H. G. CHAMPION)

SOME JUNGLE BIRD ASSOCIATIONS

BY

M. D. LISTER

(*With a map*)

This paper contains a short comparative account of the birds found by the writer in such of the major forest types in India and Burma as he happened to visit during the years 1942–1945.

During the last 6–7 decades much work has been done in the study of forest classification throughout the world. The most comprehensive survey of the types occurring in India and Burma is that published by Mr. H. G. Champion (1936) who puts forward a tentative classification of the main forest types based on four temperature zones, tropical, subtropical, temperate and alpine, each subdivided according to the available amount of moisture as reflected by the relative importance of evergreen, deciduous and thorny trees. Important edaphic variations as well as certain primary and secondary seral types are also listed.

A given square mile of country in any of the major forest types may contain several distinct sub-types as well as edaphic or seral variants and an ideal comparative study of the avifauna would cover concurrently large areas of each main type, including examples of all the major components, for long periods at all seasons of the year. Such a survey would be a very big undertaking requiring the co-operation of many observers, but until it is possible to organise such a survey preliminary information can be collected from smaller surveys of more limited areas. In the present case no properly controlled survey was possible, and the present records were derived from various incomplete samples of varying duration, made at different seasons under very varying conditions. The comparisons, therefore, are by no means complete, but they may perhaps have some value as a pointer for later work.

Certain minor habitat types within the major ones, e.g. tanks, have not been treated separately in this paper, as it was well-nigh impossible to separate them satisfactorily in the circumstances under which the surveys were made, and this accounts for the presence in the lists of such unexpected species as terns, which may perhaps have been seen at an isolated tank surrounded by a considerable area of jungle. Soaring and high flying birds have been included as these obtain much of their food directly or indirectly from the jungle.

The classification of forests here adopted is that contained in Mr. Champion's paper.[1] The writer was not aware of that paper until after he had left India and he has been unable to establish beyond doubt to which sub-type the various areas of jungle under survey belonged.

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[1] CHAMPION, H. G. (1936). 'A Preliminary Survey of the Forest Types of India and Burma'. *Ind. For. Rcds.* (*New Series*), *Sylviculture*, Vol. 1, No. 1, 1–287.

Summary of Surveys made

I. Moist Tropical Forests

A. *Tropical Wet Evergreen Forest*:	1. Myitkyina	(*a*) forest (*b*) scrub.
B. *Tropical Semi-evergreen Forest*:	2. Jessore	(*a*) forest
	3. Dhubalia	(*a*) forest
C. *Tropical Moist Deciduous Forest*:	4. Ramgarh	(*a*) forest
	5. Digri	(*a*) forest (*b*) scrub.

II. Dry Tropical Forests

D. *Tropical Dry Deciduous Forest*:	6. Monywa	(*a*) forest (*b*) scrub
E. *Tropical Thorn Forest*:	7. Ambala	(*a*) forest
	8. Delhi	(*a*) forest (*b*) scrub
	9. Okhla	(*b*) scrub

III. Montane Sub-tropical Forests

F. *Sub-tropical Wet Hill Forest*:	10. Darjeeling	(*a*) forest

I. Moist Tropical Forests

A. *Tropical Wet Evergreen Forest*

1. Myitkyina, North Burma: Position: 25° 30′N × 97° 25′E Altitude: approx. 470′ A.S.L. Period of survey: 24-27 March, 1945; almost continuous observation. Locality: although the forest in much of the surrounding country is of this type, the only subtypes visited here were a small citrus orchard and an area of scrub. The latter was, I think, clearly a seral form of vegetation as it lay to a great extent on the bed of a fairly recently dried-up meander of the Irrawaddy. The vegetation may also have been influenced by the felling of the larger trees to provide a clear air approach to the landing ground. which lay between the bed of the meander and the main river.

(*a*) Tree Forest: Some 5-6 acres of overgrown citrus orchard on the right bank of the Irrawaddy. Some trees cut down to make room for huts and tents. Some rough thin bushes round the edges with a few teak (*Tectona grandis*) and (?) *Bombax* trees.

(*b*) Scrub: A large area of dense scrub, in places consisting of fairly large bushes with a sprinkling of trees of medium size, including a few bamboos and (?) *Bombax*; in other places the vegetation consisted of considerable areas of a leafless woody scrub of medium height, almost like some sort of crop (not identified). The whole area was intersected by several paths and grassy rides. One long visit of several hours on foot. Major battles had recently been fought in this area and signs of this were still very obvious.

B. *Tropical Semi-evergreen Forest*

2. Jessore, Lower Bengal: Position: 23° 11′N × 89° 10′E. Inland portion of delta area. Altitude: 20′ A.S.L. Period of survey: 14 April, 1943—9 Sept., 1944 (with three breaks of a fortnight each and one in Sept., 1943 of a month). Locality: this probably lies in Champion's C4 category (Chittagong Tropical Evergreen Forest). There were considerable areas of mature forest, though some patches, judging by the absence of large trees, were only of a secondary nature and in many places the forest was very broken. The greater part of the district is devoted to rice growing, with some jute, and the vegetation was always very luxuriant.

(*a*) Tree Forest: The whole of this area of several square miles consists of extensive stretches of paddy and jute fields round a small, well-wooded Indian town, set in a matrix of patchily dense jungle. Dominant trees in many of the jungle patches were mango (*Mangifera indica*), bamboos (? species), with coconut palms (*Cocos nucifera*), date palms (*Phoenix sylvestris*), but many other trees were also well represented, including red silk cotton (*Bombax malabaricum*), banyan (*Ficus bengalensis*), jackfruit (*Artocarpus integrifolia*), and litchi (*Nephelium litchi*). The undergrowth varied from very dense to only a few scattered babool (*Acacia arabica*) bushes at the edge. Some patches of this mixed jungle, I think, probably represented the climatic climax, but more often, judging from the absence of really mature trees, they were only of a secondary seral nature, representing a small residue of the original jungle (the larger figs, mangoes &c) mixed with younger regeneration growth after considerable human interference.

The roads were nearly all bordered with trees and in some places bushes and patches of jungle. Here the dominant trees were, in most places, peepal (*Ficus religiosa*), in one place I think tamarind (*Tamarindus indicus*), with a smaller proportion of babool, banyan, mango and coconut and palmyra palms (*Borassus flabelliformis*). Small groves of palms were scattered all over the paddy fields, usually with no undergrowth and the paddy growing beneath them.

The whole of the urban area is liberally sprinkled with tanks, but it was not practicable to treat these as a separate habitat; their avifauna, if indeed they really have a distinct one, is usually submerged in that of the major habitat in which they are situated.

3. Dhubalia, Lower Bengal: Position: 23° 30′N × 88° 27′E. Lower Gangetic Plain. Altitude: about 45′ A.S.L. Period of survey: 11 Sept.,—11 Dec., 1944 (except 10-31 Oct.). Locality lies 60-70 miles W.N.W. of Jessore and much nearer to the Tropical Moist Deciduous Forest region. I think it is rather drier than Jessore, though temperature and rainfall data (q.v.)

were not available for the whole year, and the vegetation rather less luxuriant, with the forest more patchy and broken.

(*a*) Tree Forest: The whole countryside is broken up by rough, untidy 'hedges' and small patches of mixed jungle consisting of large straggling bushes growing in a dense tangle, with trees of various kinds. Some of the 'hedges' were swollen into considerable belts of bushes. Undergrowth varied from place to place. Dominant trees difficult to determine, but tamarind (*Tamarindus indicus*), Mango and various palms, including palmyras, probably predominated. My bungalow stood under the dense canopy of a large mango grove (1½–2 acres) with only a little undergrowth at the extreme edges. I think that none of the jungle seen here represented the climatic climax, and that it consisted of a secondary seral type interspersed in a few places with the sub-type called by Champion 'Gangetic Saline Scrub'.

I have already dealt more fully with the birds seen at Jessore and Dhubalia in 'Some Bird Associations of Bengal' (*J. Bomb. N. H. S.* Vol. 49 (4), April, 1951).

C. *Tropical Moist Deciduous Forests*

4. Ramgarh, Bihar: Position: 23° 38′N × 85° 34′E. Altitude: approx. 2,000′ A.S.L. Period of survey: 25 May—3 June, 1942; almost continuous observation. Locality: The jungle here was richer, higher, denser and more varied than at Digri, and I suspect that it represented the climatic climax, but I was not qualified to identify any of the trees with certainty.

(*a*) Tree Forest: A large camp carved out of rather light, deciduous woodland with bushes (? *Laureaceae*) and many trees of varying size (including some *Ficus* and a very few palms). The whole terrain was rough and irregular with many nullahs. The value of the survey here was greatly limited owing to my unfamiliarity with the species seen, as I had only just arrived in India.

5. Digri, S. W. Bengal: Position: approx. 22° 47′N × 87° 23′E. Altitude: about 200′ A.S.L. Period of survey: 8 March—8 April, 1943. Locality: this was in an area of Sal (*Shorea robusta*) forest (probably Champion's 'Wet Sal'), with small patches of larger mixed trees.

(*a*) Tree Forest: Some 50 acres of light woodland with many bamboos (? species) some 20-30′ high, and a good sprinkling of larger deciduous trees of various kinds (including some large *Ficus*). A fair number of thatched busti huts under the trees, and some Mess kitchens whose refuse was a great attraction to the ubiquitous Pariah Kites. Also considerable patches of sal, 25-30′ high, which were under only occasional observation from near the edge and so not worth treating separately.

(*b*) Scrub: About 1 square mile of fairly level, rough, broken ground, about 40% of which was covered with low, thorny scrub; bushes nowhere more than 2-3′ high. Sparse, patchy grass and weeds in the open ground between the scrub. Daily observation, usually from an open truck or motor cycle, but sometimes on foot.

II. DRY TROPICAL FORESTS

D. *Tropical Dry Deciduous Forest*

6. Monywa, Lower Chindwin, Burma: Position: 22°00′N×95° 05′E. Altitude: approx. 300′ A.S.L. Period of survey: 3-6 March, 1945 and 30 March–2 April, 1945. Fairly continuous observation. Locality: lies near northern end of the dry zone of Burma and not far to the south of the Tropical Moist Deciduous Forest region. None of the area I visited appeared to have any climatic climax forest.

(*a*) Tree Forest: An extensive area composed of a mixture of more or less derelict compounds about the edge of the town, all well-wooded, mostly with light-leaved trees of the *Acacia* type (though other species were quite well represented); of roadside trees of various kinds, and clumps and whole areas of bushes and scrub. Also a stretch of road out to the aerodrome some 2-3 miles long, bordered on each side by a continuous line of trees, predominantly neem (*Melia*), and here and there a tamarind (*Tamarindus indicus*), an occasional babool (*Acacia arabica*) and a few other species; there was also a light thorn hedge bordering much of the road. Frequent visits, usually in an open truck.

(*b*) Scrub: About 10 acres of rough grass, with a patchy growth of low scrub and a sprinkling of larger thorn bushes (not identified). Daily visits on foot.

E. *Tropical Thorn Forest*

7. Ambala, Punjab: Position: 30° 25′N×76°50′E. Altitude: about 900′ A.S.L. Period of survey: 7 July–5 Aug., 1942. Several visits. Locality: lies very near the Tropical Dry Deciduous Forest region.

(*a*) Tree Forest: A small plain about ½ mile × ½ mile, covered with babool trees, a few of which were in flower. Ground covered with grass on which cattle, goats, etc., were grazed. No undergrowth. A few other species of trees growing round the edges.

8. New Delhi: Position: 28° 45′N × 77° 20′E. Altitude: 718′ A.S.L. Period of survey: 15 August—29 December 1942. Frequent observation. Locality lies near the junction of this type with the Tropical Dry Deciduous Forest region and area (1) below is probably more representative of that kind.

(*a*) Tree Forest: (1) Rough deciduous woodland with mixed trees and a few palms. Many *Acacia arabica*. Fairly dense low undergrowth.

(2) Part of the golf course, including: (i) a patch of light deciduous woodland with a fair amount of undergrowth, in places low and thin, in others tall and dense and including a fair number of climbers. (ii) Another patch of open deciduous woodland with no undergrowth except rough grass and weeds and a few small bushes at the edge (5 acres), and a patch of some 5 acres of much denser light deciduous woodland (chiefly *Acacia arabica*) with a good deal of undergrowth, and about 10 acres of rough grassland with isolated trees and bushes varying from semi-scrub, a foot or so high, to thorn and bramble bushes 12–15′ high. Part of this area was subject to disturbance from September onwards when a large tented camp was erected on it. (iii) The golf course proper, consisting of fairly rough grass bordered by a thick growth of deciduous trees and dense patches of bushes in which stood small scattered ruins. It was not practicable to treat the grass as an entirely separate habitat from the surrounding jungle.

(3) A large patch of fairly dense deciduous woodland (almost entirely an *Acacia* known locally as Kabul Babool, whose species I never discovered), standing 15–20′ high, with a scattering of other trees. The canopy was so dense in most places that nothing would grow under it except a little sparse, weak grass, though most of the branches were high enough for a man to be able to walk upright under them. A certain amount of interlacing rough open ground running through the wood, with rough grass and a few bushes, and many tiny interlacing ponds only a yard or two across with here and there a larger one. Most of these ponds were empty though damp and covered with moss and herbage; no doubt during the rainy season this area becomes a bog.

(*b*) Scrub: A patch some 300 × 400 yds. of thorn bushes of the drooping or 'weeping' kind (? a kind of *Acacia*), of average height 8–10 ft. and quite impenetrable except along cart tracks. Here and there an *Acacia arabica* and a fair sprinkling of a low-growing tamarisk (? *T. gallica*) in the more open parts. Probably Champion's 'Dry Deciduous Scrub Forest'. Observation was confined to the limits of vision from the cart tracks.

9. Okhla, near Delhi: Position: some 7–8 miles S.E. of New Delhi. Altitude: about 700′ A.S.L. Period of survey: a single visit of several hours devoted to observation on 1st November 1942. Locality: as for New Delhi.

(*b*) Scrub; a dense belt of scrub and bushes (not identified), 50–100 yards wide along the top of the river bank. In most places impenetrable. Some tamarisk and a few tamarind trees.

III. MONTANE SUB-TROPICAL FORESTS

F. *Sub-tropical Wet Hill Forest*

10. Darjeeling, North Bengal: Position: 27° 03′N×88° 18′ E. Altitude of areas surveyed: 1,800–6,500′ A.S.L., though preponderance of observation was 3,000–6,000′. Periods of survey: I paid 7 visits to 3 tea gardens near Darjeeling, lasting 2–4 weeks each in the months of January,

February, March, April, May, June and October, and almost the whole of this time was spent in bird watching. Locality : although Darjeeling itself lies in the Montane Temperate Forest Region, the tea gardens on which most of my observation was done lay well below it and should, I think, be included in this category under Champion's 'Upper Bengal Sub-tropical Hill Forest' type.

(*a*) Tree Forest : All these three tea estates were basically similar in that they consisted of patches of tea bushes [*Camellia thea* (Link)] of varying extent, set in a matrix of mixed jungle on the steep hillsides. They differed in the proportions of tea to jungle, total acreage, aspect, in the use of shade trees and leguminous plants interplanted among the tea, in the intensiveness of the forestry methods practised, and such minor points as the turfing or walling of the terraces on which the tea was planted. The hillsides were frequently broken with small jungle-clad ravines with small streams.

The jungle was for the most part a widely varied mixture of deciduous trees and it was difficult to say just what species predominated. Utis (*Betula alnoides*) and toon (*Cedrela toona*) were usually well represented, and here and there were small patches of bamboos (? species). In some places were *Cryptomerias* growing in groves or clumps or as isolated trees. Undergrowth varied from barely any to a dense covering of bushes and brambles, with here and there a tree fern. Luxuriant herbage sprang up during the rainy season.

I have included the tea in this type as the tea plantations and the jungle were so intermixed as to be almost inseparable as distinct habitats with any degree of accuracy, and most of the birds to be found in the one could also be seen, at any rate at times, in the other. The chief shade trees interplanted among the tea were Sau or Black Siris (*Albizzia stipulata*) and Koroi or White Siris (*A. procera*). The principal leguminosae interplanted were Indigofera (*I. dosua*), Boga Medeloa (*Tephrosia candida*) and in some places *Crotellaria*.

I have not thought it worth while to give comparative lists for these three gardens, and a single composite list for the Darjeeling area has therefore been included in the main comparative Table.

CLIMATE

Myitkyina :

Temp. °F...	J.	F.	M.	A.	M.	J.	Jy.	A.	S.	O.	N.	D.	Year.
Mean max. ...	74	78	85	89	92	88	87	87	90	86	80	75	...
Mean min. ...	50	54	61	67	73	75	76	76	76	71	61	52	...
Rainfall ...	0·4	0·9	0·9	2·0	6·0	15·1	19·2	16·4	9·7	6·8	1·2	0·4	79·0″

Months with less than 2″ of rain—5.

Jessore : April 1943 to September 1944.

Temp. °F.	—	—	—	91	95	—	84	89	90	91	86	80	—
Mean max. ...	73	79	84	92	98	91	89	88	—	—	—	—	—
Mean min. ...	—	—	—	71	77	—	77	77	78	73	60	56	—
	53	57	64	73	79	78	79	78	—	—	—	—	—
Rainfall ...	—	—	—	5·2	2·3	—	16·2	13·6	4·9	6·4	0·0	0·0	—
	5·8	1·1	3·5	4·5	3·0	4·6	13·5	13·3	—	—	—	—	77·0″

Months with less than 2″ of rain : 3.

Dhubalia : September—November 1944 only. No other records available.

Temp. °F.	J.	F.	M.	A.	M.	J.	Jy.	A.	S.	O.	N.	D.	Year.
Mean max. ...	—	—	—	—	—	—	—	—	90	88	84	—	—
Mean min. ...	—	—	—	—	—	—	—	—	78	72	56	—	—
Rainfall ...	—	—	—	—	—	—	—	—	2·6	1·0	0·0	—	—

Monywa : Nearest available station—Mandalay (250 ft. A.S.L.)

Temp. °F.													
Mean max. ...	84	90	98	102	101	94	93	92	90	92	94	94	106
Mean min. ...	59	60	69	81	82	79	79	78	78	75	68	62	53
Rainfall ...	0·1	0·1	0·2	1·1	5·9	5·5	5·3	4·6	5·7	4·7	1·6	0·4	33·2″

Months with less than 2″ of rain : 6. Mean annual humidity 64.

Ambala : No information available to me.

Delhi :

Temp. °F.													
Mean max. ...	71	75	88	99	104	105	95	94	94	92	83	74	116
Mean min. ...	48	52	62	72	78	84	81	80	77	68	56	49	40
Rainfall ...	1·0	0·5	0·7	0·4	0·7	3·4	8·5	6·9	4·5	0·5	0·1	0·4	27·6″

Months with less than 2″ of rain : 8. Mean annual humidity 51.

Ramgarh : no information available to me.

Digri : do. do. do.

Darjeeling (at 6,912 ft) :

Temp. °F.													
Mean max. ...	50	53	61	67	68	69	70	70	69	66	60	54	78
Mean min. ...	35	37	44	50	53	58	59	59	57	51	43	37	30

Rainfall—no record.

Only fragmentary records are available to me from the three tea gardens at which I stayed.

Comparative Table

showing the occurrence of species
in Tree and Scrub Jungle in the
various places surveyed.

The following symbols have been used :

✱ = definite, beyond any doubt.
† = probable, but not definite, identification.
⊙ = possible identification.
△ = reported by someone else, but not actually seen by me.

The scientific names are in the main those given in the 2nd edition of *The Fauna of British India Birds*. The columns should be read in conjunction with the Summary of Surveys Made on pp. 574–580.

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	*b*	*a*	*a*	*a*	*a*	*b*	*a*	*b*	*a*	*a*	*b*	*b*	*a*
Jungle Crow (*Corvus macrorhynchos*)	*		*	*	*	*				*				*
House Crow (*Corvus splendens*)	*		*	*	*	*	*	*		*	*		*	*
Red-billed Blue Magpie (*Urocissa erythrorhyncha*)	*	*												
Yellow-billed Blue Magpie (*Urocissa flavirostris*)														*
Green Magpie (*Cissa chinensis*)														*
Tree Pie (*Dendrocitta vagabunda*)			*	*	*			*			*			
Himalayan Tree Pie (*Dendrocitta formosae*)														*
Indian Grey Tit (*Note* 1) (*Parus major*)			*	*	*									†
Green-backed Tit (*Parus monticolus*)														*
Yellow-cheeked Tit (*Machlolophus xanthogenys*)					⊙									†
Red-headed Tit (*Aegithaliscus concinnens*)														*
Sultan Tit (*Melanochlora sultanea*)														*
Cinnamon-bellied Nuthatch (*Sitta castanea*)														*
Velvet-fronted Nuthatch (*Sitta frontalis*)														*
Rufous-necked Laughing Thrush (*Dryonastes ruficollis*)														*
Grey-sided Laughing Thrush (*Dryonastes caerulatus*)														†
Black-gorgetted Laughing Thrush (*Garrulax pectoralis*)														†
Necklaced Laughing Thrush (*Garrulax moniliger*)														†
White-throated Laughing Thrush (*Garrulax albogularis*)														*
Rufous-chinned Laughing Thrush (*Ianthocincla rufogularis*)														†
Red-headed Laughing Thrush (*Trochalopteron erythrocephalum*)														*
Crimson-winged Laughing Thrush (*Trochalopteron phoeniceum*)														†
Striated Laughing Thrush (*Grammatoptila striata*)														†
Jungle Babbler (*Turdoides terricolor*)			*	*	*					*	*	*	*	

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	b	a	a	a	a	b	a	b	a	a	b	b	a
Common Babbler (*Argya caudata*)				*							*			
Large Grey Babbler (*Argya malcolmi*)										*	*		*	
Rusty-cheeked Scimitar Babbler (*Pomatorhinus erythrogenys*)														*
Red-capped Babbler (*Timalia pileata*)		*		*				*						
Yellow-eyed Babbler (*Chrysomma sinensis*)		†						†			†			
Spotted Babbler (*Pellorneum ruficeps*)		†												†
Abbott's Babbler (*Malacocincla sepiaria abbotti*)			†											
Black-throated Babbler (*Stachyris nigriceps*)														*
Red-headed Babbler (*Stachyridopsis ruficeps*)														*
Hume's Babbler (*Stachyridopsis rufifrons*)	†													
Yellow-breasted Babbler (*Mixornis gularis*)														†
White-eyed Quaker Babbler (*Alcippe nepalensis*)														*
Black-headed Sibia (*Leioptila capistrata*)														*
Stripe-throated Yuhina (*Yuhina gularis*)														*
Yellow-naped Ixulus (*Ixulus flavicollis*)														*
Red-billed Leiothrix (*Leiothrix lutea*)														*
Nepal Cutia (*Cutia nipalensis*)														†
Red-winged Shrike-Babbler (*Pteruthius erythropterus*)														*
Common Iora (*Aegithina tiphia*)			*	*	*									
Marshall's Iora (*Aegithina nigrolutea*)											†			
Orange-bellied Chloropsis (*Chloropsis hardwickii*)														*
Jerdon's Chloropsis (*Cholorospsis jerdoni*)				*		†								
Silver-eared Mesia (*Mesia argentauris*)														†
Red-tailed Minla (*Minla ignotincta*)														*

Species	I							II						III
	A		B		C			D						F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeelin
	a	*b*	*a*	*a*	*a*	*a*	*b*	*a*	*b*	*a*	*a*	*b*	*b*	*a*
Himalayan Black Bulbul (*Microscelis psaroides*)														
Himalayan Brown-eared Bulbul (*Ixos flavala*)														
Himalayan Rufous-bellied Bulbul (*Ixos macclellandi*)														†
Striated Green Bulbul (*Alcurus striatus*)														*
Red-vented Bulbul (*Molpastes cafer*)	*	*	*	*	*	*				*	*		*	*
White-cheeked Bulbul (*Molpastes leucogenys*)											*			*
Red-whiskered Bulbul (*Otocompsa jocosus*)		*	*	*				*						
White-browed Bulbul (*Pycnonotus luteolus*)											*			
Scaly-breasted Wren (*Pnoepyga albiventris*)														†
Indian Brown Dipper (*Cinclus pallasii*)														*
Indian Blue Chat (*Larvivora brunnea*)														†
White-browed Shortwing (*Heteroxenicus cruralis*)														†
Burmese Stonechat (*Saxicola caprata*)		*						*	*					
Indian Bush Chat (*Saxicola torquata*)														*
Dark Grey Bush Chat (*Rhodophila ferrea*)														*
Spotted Forktail (*Enicurus maculatus*)														*
Little Forktail (*Microcichla scouleri*)														*
Blue-fronted Redstart (*Phoenicurus frontalis*)														*
Black Redstart (*Phoenicurus ochrurus*)		*									*			*
White-capped Redstart (*Chaimarrornis leucocephala*)														*
Plumbeous Redstart (*Rhyacornis fuliginosa*)														*
Red-spotted Bluethroat (*Cyanosylvia suecica*)											*			
Red-flanked Bush Robin (*Ianthia cyanura*)														†
White-tailed Blue Robin (*Muscisylvia leucura*)														*

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	*b*	*a*	*a*	*a*	*a*	*b*	*a*	*b*	*a*	*a*	*b*	*b*	*a*
Brown-backed Indian Robin (*Saxicoloides fulicata*)					*					*	*			
Magpie Robin (*Copsychus saularis*)	*		*	*		*		*		*	*			*
Black-capped Blackbird (*Turdus merula*)					⊙									
White-collared Blackbird (*Turdus merula albocinctus*)														†
Grey-winged Blackbird (*Turdus boulboul*)														*
Red-throated Thrush (*Turdus ruficollis*)														⊙
Black-throated Thrush (*Turdus atrogularis*)														*
Orange-headed Ground Thrush (*Geokichla citrina*)			*	*										
Plain-backed Mountain Thrush (*Oreocincla mollissima*)														†
Lesser Brown Thrush (*Zoöthera marginata*)														†
Chestnut-bellied Rock Thrush (*Monticola rufiventris*)														*
Blue-headed Rock Thrush (*Monticola cinchlorhyncha*)														*
Blue Rock Thrush (*Monticola solitaria*)														*
Himalayan Whistling Thrush (*Myophonus caeruleus*)														*
Maroon-backed Accentor (*Prunella immaculata*)														⊙
Sooty Flycatcher (*Hemichelidon sibirica*)														†
Ferruginous Flycatcher (*Hemichelidon ferruginea*)														†
Red-breasted Flycatcher (*Siphia parva*)			*	*										*
Indian Little Pied Flycatcher (*Muscicapula melanoleuca*)														*
Tickell's Blue Flycatcher (*Cyornis tickelliae*)														*
Verditer Flycatcher (*Eumyias thalassina*)			*											*
Grey-headed Flycatcher (*Culicicapa ceylonensis*)														*
Large Sikkim Niltava (*Niltava grandis*)														†
Rufous-bellied Niltava (*Niltava sundara*)														*

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	b	a	a	a	a	b	a	b		a	b	b	a
Small Niltava (*Niltava macgrigoriae*)														*
Paradise Flycatcher (*Tchitrea paradisi*)			*	*	*									
Black-naped Flycatcher (*Hypothymis azurea*)			*	*										⊙
Yellow-bellied Flycatcher (*Chelidorhynx hypoxanthum*)														*
White-browed Fantail Flycatcher (*Leucocirca aureola*)			*	*							*			
White-throated Fantail Flycatcher (*Leucocirca albicollis*)														*
Indian Grey Shrike (*Lanius excubitor*)											*	*		
Bay-backed Shrike (*Lanius vittatus*)			*								*			
Burmese Shrike (*Lanius collurioides*)		*						*	*					
Black-headed Shrike (*Lanius nigriceps*)			*											*
Rufous-backed Shrike (*Lanius schach erythronotus*)			*								*			
Grey-backed Shrike (*Lanius schach tephronotus*)	*													*
Brown Shrike (*Lanius cristatus*)		*		*										
Brown-backed Pied Shrike (*Hemipus picatus capitalis*)														*
Nepal Wood Shrike (*Tephrodornis gularis*)														*
Indian Common Wood Shrike (*Tephrodornis pondiceriana*)			*	*										
Scarlet Minivet (*Pericrocotus flammeus*)														*
Short-billed Minivet (*Pericrocotus brevirostris*)														*
Small Minivet (*Pericrocotus peregrinus*)			*	*	⊙						*			
Dark Grey Cuckoo Shrike (*Lalage melaschista*)														*
Ashy Swallow Shrike (*Artamus fuscus*)			*	*										*
Black Drongo (*Dicrurus macrocercus*)	*	*	*	*	*	*	*	*		*	*		*	*
Grey Drongo (*Dicrurus leucophaeus*)											*			*
White-bellied Drongo (*Dicrurus coerulescens*)			†											

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jossore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	*b*	*a*	*a*	*a*	*a*	*b*	*a*	*b*	*a*	*a*	*b*	*b*	*a*
Bronzed Drongo (*Chaptia aenea*)														*
Hair-crested Drongo (*Chibia hottentotta*)	*													*
Blyth's Reed Warbler (*Acrocephalus dumetorum*)			*	†							*			
Tailor Bird (*Orthotomus sutorius*)			*	*				*			*		*	*
Streaked Fantail Warbler (*Cisticola juncidis*)											*			
Franklin's Wren Warbler (*Franklinia gracilis*)											†			
Sykes's Tree Warbler (*Hippolais rama*) or Booted Warbler (*Hippolais scita*)			†								†	†		
Grey-faced Willow Warbler (*Phylloscopus maculipennis*)														†
Yellow-rumped (Pallas' Himalayan) Willow Warbler (*Phylloscopus proregulus*)														†
Yellow-browed (Crowned) Willow Warbler (*Phylloscopus humii*)				†							†			
Large Crowned Willow Warbler (*Acanthopneuste occipitalis*)								†						
Grey-headed Flycatcher Warbler (*Seicercus xanthoschistus*)														*
Chestnut-headed Flycatcher Warbler (*Seicercus castaniceps*)														*
Strong-footed Bush Warbler (*Homochlamys fortipes*)														*
Rufous-capped Bush Warbler (*Horeites brunnifrons*)														*
Brown Hill Warbler (*Suya criniger*)														*
Black-throated Hill Warbler (*Suya atrogularis*)														*
Streaked Wren Warbler (*Prinia gracilis*)												†		
Ashy Wren Warbler (*Prinia socialis*)				†							†			
Jungle Wren Warbler (*Prinia sylvatica*)											*			
Indian Wren Warbler (*Prinia inornata*)											*			

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	b	a	a	a	a	b	a	b	a	a	b	b	a
Indian Oriole (*Oriolus o. kundoo*) ...			*		*						*			
Indian Black-headed Oriole (*Oriolus xanthornus*) ...			*	*		*								
Maroon Oriole (*Oriolus traillii*) ...														*
Grey-headed Myna (*Sturnia malabarica*) ...			*	*		*					*			*
Black-headed (Brahminy) Myna (*Temenuchus pagodarum*) ...											*		*	
Black-necked Myna (*Gracupica nigricollis*) ...		*												
Jerdon's Myna (*Gracupica burmanica*) ...								*						
Common Myna (*Acridotheres tristis*) ...	*		*	*	*	*	*	*	*	*	*	*	*	*
Bank Myna (*Acridotheres ginginianus*) ...			*								*			
Jungle Myna (*Aethiopsar fuscus*) ...			*			*								
Pied Myna (*Sturnopastor contra*) ...		*	*	*	*	*					*			
Baya Weaver Bird (*Ploceus philippinus*) or Eastern Baya Weaver Bird (*Ploceus atrigula*) ...		*		*				*				*		
Himalayan White-backed (Hodgson's) Munia (*Uroloncha striata*) ...														*
White-throated Munia (*Uroloncha malabarica*) ...				*							*	*		
Spotted Munia (*Uroloncha punctulata*) ...														*
Scarlet Finch (*Haematospiza sipahi*) ...														*
Himalayan Greenfinch (*Hypacanthis spinoides*) ...														*
House Sparrow (*Passer domesticus*) ...	*		*		*			*	*	*	*			
Malay Tree Sparrow (*Passer montanus*) ...														*
Pegu House Sparrow (*Passer flaveolus*) ...									*					
White-capped Bunting (*Emberiza stewarti*) ...											†			
Hodgson's House Martin (*Delichon nipalensis*) ...														†

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okala	Darjeeling
	a	b	a	a	a	a	b			a	a	b	b	a
Eastern Swallow (*Hirundo rustica*)								*						*
Striated Swallow (*Hirundo daurica*)								*			*			*
Indian White Wagtail (*Motacilla alba dukhunensis*)								*						
White-faced Wagtail (*Motacilla leucopsis*)	*													
Eastern Grey Wagtail (*Motacilla cinerea*)														*
Indian Blue-headed Wagtail (*Motacilla flava beema*)				†										
Grey-headed Wagtail (*Motacilla f. thunbergi*)			†											
Yellow-headed Wagtail (*Motacilla citreola*)		*	*											
Tree Pipit (*Anthus hodgsoni*)	*		*											*
Indian Pipit (*Anthus richardi rufulus*)		†		*	†			*	*		*			
Vinous-breasted (Hodgson's) Pipit (*Anthus roseatus*)														†
Short-toed Lark (*Calandrella brachydactyla*)							⊙							
Burmese Bush Lark (*Mirafra assamica microptera*)		*							*					
Red-winged Bush Lark (*Mirafra erythroptera*)											*			*
White-eye (*Zosterops palebrosa*)			*											*
Black-breasted Sunbird (*Aethopyga saturata*)														*
Yellow-backed Sunbird (*Aethopyga siparaja*)														*
Purple Sunbird (*Cinnyris asiatica*)			*		*			*			*		*	
Purple-rumped Sunbird (*Note* 2) (*Cinnyris zeylonica*)			*	*						*				
Indian Streaked Spider Hunter (*Arachnothera magna*)														*
Tickell's Flowerpecker (*Dicaeum erythrorhynchum*)			*	*	*									
Thick-billed Flowerpecker (*Dicaeum agile*)			*											
Indian Pitta (*Pitta brachyura*)			*											
Long-tailed Broadbill (*Psarisomus dalhousiae*)														*

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	*b*	*a*	*a*	*a*	*a*	*b*	*a*	*b*	*a*	*b*	*a*	*b*	*a*
Little Scaly-breasted Green Woodpecker (*Picus vittatus*)			*											
Black-naped Green Woodpecker (*Picus canus*)														*
Small Yellow-naped Woodpecker (*Picus chlorolophus*)														*
Large Yellow-naped Woodpecker (*Chrysophlegma flavinucha*)														*
Pale-headed Woodpecker (*Gecinulus grantia*)														†
Darjeeling Pied Woodpecker (*Dryobates darjellensis*)														*
Himalayan Lesser Pied Woodpecker (*Dryobates cathpharius*)														*
Fulvous-breasted Pied Woodpecker (*Dryobates macei*)														*
Yellow-fronted Pied (Mahratta) Woodpecker (*Dryobates mahrattensis*)			*	*							*			
Darjeeling Pygmy Woodpecker (*Dryobates nanus semicoronatus*)														*
Red-eared Bay Woodpecker (*Blythipicus pyrrhotis*)														†
Golden-backed Woodpecker (*Brachypternus bengalensis*)			*	*										
Tickell's Golden-backed Woodpecker (*Chrysocolaptes guttacristatus*)			*											*
Speckled Piculet (*Vivia innominatus*)														*
Rufous Piculet (*Sasia ochracea*)														*
Wryneck (*Jynx torquilla*)			*											
Great Himalayan Barbet (*Megalaima virens*)														*
Green Barbet (*Megalaima zeylanicus*)			*								*			
Lineated Barbet (*Megalaima lineatus*)	*		†											
Blue-throated Barbet (*Megalaima asiatica*)	*		*	*										*
Golden-throated Barbet (*Megalaima franklinii*)														*
Crimson-breasted Barbet (Coppersmith) (*Megalaima haemacephala*)	*		*	*		*		*			*			
Asiatic Cuckoo (*Cuculus canorus*)					⊙									*

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	*b*	*a*	*a*	*a*	*a*	*b*	*a*	*b*	*a*	*a*	*b*	*b*	*a*
Himalayan Cuckoo ... (*Cuculus optatus*)														*
Small Cuckoo ... (*Cuculus poliocephalus*)														*
Indian Cuckoo ... (*Cuculus micropterus*)			*											*
Large Hawk Cuckoo ... (*Hierococcyx sparverioides*)														*
Common Hawk Cuckoo ... (*Hierococcyx varius*)			*	*		*								
Indian Plaintive Cuckoo ... (*Cacomantis merulinus*)			†	*										*
Indian Drongo Cuckoo ... (*Surniculus lugubris*)														*
Pied Crested Cuckoo ... (*Clamator jacobinus*)			*	*						*	*			
Red-winged Crested Cuckoo ... (*Clamator coromandus*)														*
Indian Koel ... (*Eudynamis scolopaceus*)	*		*	*	*	*				*	*			
Large Green-billed Malkoha ... (*Rhopodytes tristis*)														†
Crow-Pheasant ... (*Centropus sinensis*)		*	*	*	*								*	
Large Parakeet ... (*Psittacula eupatria*)			†	†		†								
Rose-ringed Parakeet ... (*Psittacula krameri*)					†					*	†			
Blossom-headed Parakeet ... (*Psittacula cyanocephala*)				*										
Roller ... (*Coracias bengalensis*)	*		*	*	*	*		*	*	*	*			
Broad-billed Roller ... (*Eurystomus orientalis*)														*
Common Green Bee-eater ... (*Merops orientalis*)	*	*	*	*	*			*	*	*	*			
Blue-tailed Bee-eater ... (*Merops superciliosus*)										*	*			
Indian Pied Kingfisher ... (*Ceryle rudis*)			*											
Common Indian Kingfisher ... (*Alcedo atthis*)			*											
Brown-headed Stork-billed Kingfisher ... (*Ramphalcyon capensis*)			*	*										
White-breasted Kingfisher ... (*Halcyon smyrnensis*)			*	*										*
Hoopoe ... (*Upupa epops*)		*								*	*			*

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	*b*	*a*	*a*	*a*	*a*	*b*	*a*	*b*	*a*	*a*	*b*	*b*	*a*
Red-headed Trogon (*Harpactes erythrocephalus*)														†
Common House Swift (*Micropus affinis*)			*		*	*	*			*	*			*
Palm Swift (*Cypsiurus batassiensis*)			*		*			*	*					
White-throated Spinetail Swift (*Hirundapus caudacutus*)														†
Long-tailed (Horsfield's) Nightjar (*Caprimulgus macrourus*)			†	†										
Jungle Nightjar (*Caprimulgus indicus*)								*						
Common Indian Nightjar (*Caprimulgus asiaticus*)					*		*				*			
Mottled Wood Owl (*Strix ocellata*)			*											
Brown Fish Owl (*Ketupa zeylonensis*)			*											
Indian Great Horned Owl (*Bubo bubo bengalensis*)											*			
Collared Scops Owl (*Otus bakkamoena*)			†	†										†
Spotted Owlet (*Athene brama*)					†	†		*		*	*			
Barred Owlet (*Glaucidium cuculoides*)														†
Jungle Owlet (*Glaucidium radiatum*)			*	*										
Collared Pygmy Owlet (*Glaucidium brodiei*)														*
King Vulture (*Sarcogyps calvus*)			*	*	*					*	*			*
Himalayan Griffon Vulture (*Gyps himalayensis*)														†
Long-billed Vulture (*Gyps indicus*)			*	*										*
Indian White-backed Vulture (*Pseudogyps bengalensis*)			*	*	*	*				*	*			*
Large White Scavenger Vulture (*Neophron percnopterus*)										*	*			
Lämmergeier (*Gypaëtus barbatus*)														†
Lagger Falcon (*Falco jugger*)												†		
Hobby (*Falco subbuteo*)														†
Kestrel (*Cerchneis tinnunculus*)														*

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	*b*	*a*	*a*	*a*	*a*	*b*	*a*	*b*	*a*	*a*	*b*	*b*	*a*
Eastern Steppe Eagle ... (*Aquila nipalensis*)														†
Hodgson's Hawk Eagle ... (*Limnaëtops nipalensis*)														†
Crested Serpent Eagle ... (*Spilornis cheela*)			*	*										*
Pallas's Fishing Eagle ... (*Haliaëtus leucoryphus*)			†											
Large Grey-headed Fishing Eagle ... (*Ichthyophaga ichthyaëtus*)			*											
Brahminy Kite ... (*Haliastur indus*)			*	*	*						*			*
Common Pariah Kite ... (*Milvus migrans govinda*)			*	*	*	*	*	*		*	*		*	*
Black-eared (*or* Large Indian) Kite ... (*Milvus migrans lineatus*)	*													*
Indian Shikra ... (*Astur badius*)											*			*
Indian Sparrow Hawk ... (*Accipiter nisus*)											†			
Bengal Green Pigeon ... (*Crocopus phoenicopterus*)			†											
Pintailed Green Pigeon ... (*Sphenocercus apicaudus*)														Δ
Green Imperial Pigeon ... (*Muscadivora aenea*)			†											
Indian Blue Rock Pigeon ... (*Columba livia*)			*	*				*			*		*	
Rufous Turtle Dove ... (*Streptopelia orientalis*)			*											
Spotted Dove ... (*Streptopelia chinensis*)	*	*	*	*	*			*	*	*	*			*
Little Brown Dove ... (*Streptopelia senegalensis*)					†						*	*	*	
Indian Ring Dove ... (*Streptopelia decaocta*)			*	*	†	*				*	*	*	*	
Red Turtle Dove ... (*Œnopopelia tranquebarica*)			*	*						*	*			
Bar-tailed Cuckoo Dove ... (*Macropygia unchall*)														†
Common Indian Peafowl ... (*Pavo cristatus*)											*			
Black-backed Kalij Pheasant ... (*Gennæus melanotus*)														*
Black-breasted *or* Rain Quail ... (*Coturnix coromandelica*)											†			
Hill Partridge ... (*Arborophila torqueola*)														*

Species	I							II						III
	A		B		C			D		E				F
	Myitkyina		Jessore	Dhubalia	Ramgarh	Digri		Monywa		Ambala	Delhi		Okhla	Darjeeling
	a	*b*	*a*	*a*	*a*	*a*	*b*	*a*	*b*	*a*	*a*	*b*	*b*	*a*
Grey Partridge (*Francolinus pondicerianus*)					⊙						*	*	*	
Common Bustard Quail (*Turnix suscitator*)				*										
White-breasted Waterhen (*Amaurornis phoenicurus*)			*	*										
Indian River Tern (*Sterna aurantia*)				*										
Red-wattled Lapwing (*Lobivanellus indicus*)											*			
Green Sandpiper (*Tringa ochropus*)			*											
Wood Sandpiper (*Tringa glareola*)			*											
Little Egret (*Egretta garzetta*)								*						
Cattle Egret (*Bubulcus ibis*)			*	*	*									
Indian Pond Heron (*Ardeola grayi*)			*	*				*			*			

Note 1. Grey Tit: I am convinced that I saw one member of this species on one of the tea gardens below Darjeeling, but unfortunately I did not make a note of the exact altitude. Until somebody shoots one there, therefore, this record will no doubt not be admitted.

Note 2. Purple-rumped Sunbird: I identified a ♂ and a ♀ beyond all doubt at Ambala on 19th July, 1942, which is some way north of the range given for this species in the *Fauna*.

HISTORY OF TRANSPLANTATION AND INTRODUCTION OF FISHES IN INDIA*

BY

S. JONES AND K. K. SAROJINI

Central Inland Fisheries Research Station, Barrackpore

(With a text map and eight figures)

SYNOPSIS

The objects of transplantation of fishes in India and introduction of exotic species into the country are mentioned and in the light of these objects the fishes are grouped as (i) game fishes (ii) food fishes (iii) larvicidal fishes and (iv) ornamental fishes. The history of transplantation and introduction of these fishes is reviewed in the context of the results achieved. Instances of accidental transplantation are mentioned. In the light of the available data suggestions for further transplantation of fishes are given.

INTRODUCTION

Though transplantation of food fishes from their natural habitat to nurseries and rearing ponds has been in vogue in India from remote times, the augmentation of the fish fauna by introduction of exotic forms and intrazonal transplantation of suitable autochthonous species for permanent establishment is of comparatively recent origin in this country. Most of the pioneering work in this field has been done by westerners, who, finding some of the upland waters similar to the rivers in their own country, tried to introduce their favourite varieties of fishes in them. The successful introduction of trout into certain hill-streams of India is an outstanding achievement of such efforts.

The Madras Fisheries Department was, probably, the first government organization to take up transplantation of fish, and its pioneering effort in this field is worth special mention. Though attempts to introduce or transplant food fishes into various localities were started over a century ago, it is only in recent years, when the food shortage in the country became acute, that these operations were intensified. While the establishment of game fishes and production of food fishes were the main objects of this work in India, another important object was the biological control of malaria. From early times ornamental fishes such as the exotic goldfish have been reared by aquarium keepers, and there exists a trade in these fishes in some of our big cities. The fishes that have been introduced or transplanted are here grouped as (1) game fishes, (2) food fishes, (3) larvicidal fishes and (4) ornamental fishes, and a historical account of their transplantations and introductions with a brief discussion of the results achieved is attempted. Routine transplantation operations for rearing and harvesting purposes without the object of permanently establishing the species in regions where they are not autochthonous are not included in the account.

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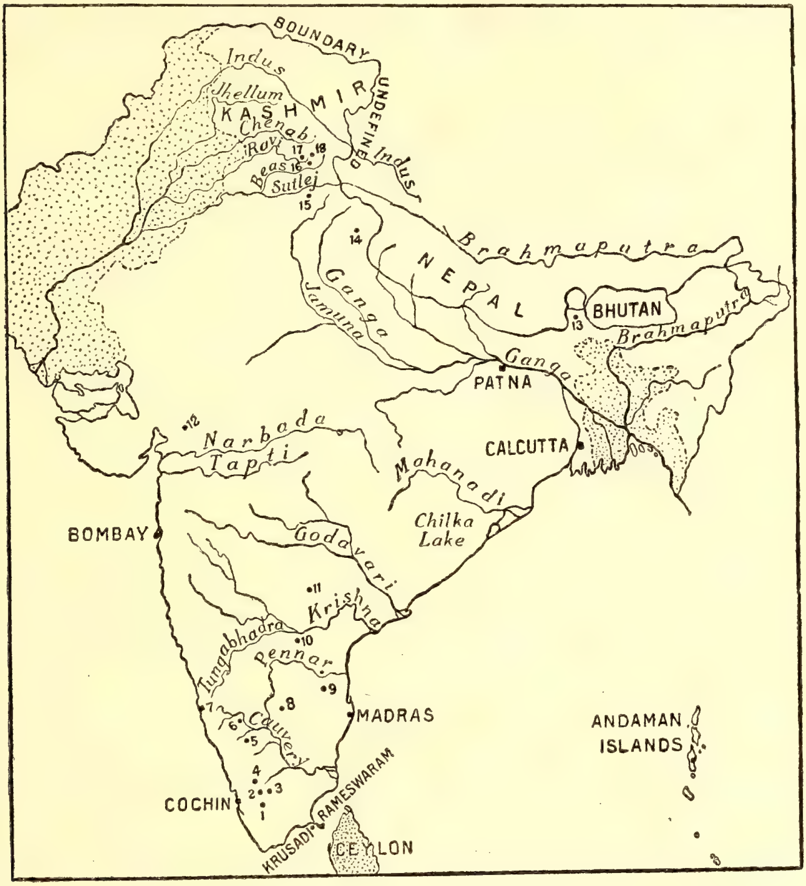
*Read at the Symposium on transplantation of fishes during the 3rd meeting of the Indo-Pacific Fisheries Council, Madras (February 1951), and published with the permission of the Chief Research Officer, Central Inland Fisheries Research Station, Barrackpore.



Outline Map of India showing the localities mentioned in the article.

Key to the numbering : 1. Periyar (Travancore) ; 2. High Ranges (Travancore); 3. Kodaikanal (Palnis) ; 4. Anamalais ; 5. Ootacamund (Nilgiris) ; 6. Mysore ; 7. Coondapur (South Canara) ; 8. Shevaroys (Salem) ; 9. Ippur (Nellore) ; 10. Sunkesula (Kurnool) ; 11. Hyderabad ; 12. Baroda ; 13. Darjeeling ; 14. Nainital (Kumaon Hills) ; 15. Simla; 16. Kangra; 17. Chamba ; 18. Kulu.

TRANSPLANTED FOOD FISHES—Autochthonous

One of the earliest recorded attempts at transplantation of fish in India, is of the Milk-fish, *Chanos chanos*, by Hyder Ali of Mysore during the latter part of the 18th century, from the sea to the Coondapur estuary in South Kanara (Thomas, 1870). Subsequently Thomas (op. cit.) transplanted some fish from the sea to the Karkal lake, but they failed to breed there.

An interesting but evidently unsuccessful attempt to transplant Hilsa *Hilsa ilisha* (Ham.) was made by Wilson (Nicholson, 1915). The eyed ova of this fish were transferred from the hatchery at the lower anicut in the Cauvery to the Ponnani river in Malabar, but there is no evidence of the fish having established itself there.

The Catla, *Catla catla* (Ham.): This is one of the major carps of India, and is reputed to be one of the fastest growing fishes in the world. Its natural distribution is from Sind and the Punjab in the north along upper India to the Krishna river in the south and as far as Burma in the east.

The successful transplantation of the fish in the south was achieved by the efforts of the Madras Fisheries Department whose then Piscicultural Assistant, Mr. H. C. Wilson, introduced the fingerlings in 1909, from the Godavari into the Cuddapah-Kurnool canal where they established themselves and spread into the Pennar river and the connected tanks in the Nellore District (Raj, 1916). Catla fingerlings from the Godavari were introduced in the year 1921 into the Cauvery river below the Hogaikanal falls and into the Bhavani (Hornell, 1924) where the fish now affords a major fishery. Catla fingerlings were sent to Cochin by Dr. Job in 1945 where they were thriving well. Fry from the Godavari river were introduced into the Periyar lake in Travancore-Cochin in 1947 (Chacko, 1948) but the result of these transplantations is not known.

The Bombay Fisheries Department transplanted catla from Patna (Bihar) into the Powai lake in Bombay where it has bred and established itself (Kulkarni, 1947).

The Rohu, *Labeo rohita* (Ham.): This is another of the major carps of India and the most esteemed fish in Bengal. Its natural distribution is from Sind and the Punjab along upper India and Assam as far as Burma. Recently it has also been reported from the Godavari (Alikunhi and Chaudhuri, 1951).

The earliest attempt to transplant this fish was made a few years previous to 1925, when fingerlings were taken from Calcutta and introduced into the fresh waters of the Andamans. Exact details are lacking, but from the records of Annandale and Hora (1925) and Mookerjee (1935) it is seen that the fish grew very well though it is doubtful if it bred there.

The Madras Fisheries Department had been regularly stocking several pieces of water in the State from 1944 to 1949 with fry obtained from Bengal and Orissa (Jaganadham 1946 and Thyagarajan & Chacko, 1950) and attempts were made to transplant the fish in the Cauvery also. Whether the fish has established itself there or not is not known. In Bombay, fry from Patna (Bihar) were introduced into the Powai lake along with *L. calbasu* (Ham.) where both are reported to have bred (Kulkarni, 1947).

The Mrigal, *Cirrhina mrigala* (Ham.): This is an important major carp of India distributed throughout upper India from North-west Provinces, the Punjab and Sind to Bengal and Assam and in upper Deccan and Burma.

The fry of mrigal have been introduced from Bengal regularly from 1943 to 1947 and from Orissa in 1949 into Madras waters including the Cauvery (Thyagarajan & Chacko, 1950) but the results of these transplantations are not available. Mrigal introduced as fry into the Powai lake in Bombay from Patna (Bihar) is reported to have bred there (Kulkarni, 1947).

The Pearl-spot, *Etroplus suratensis* (Bloch) (Fig. 1): This Cichlid, distributed in brackish and fresh waters along the coastal tracts of Peninsular India from Malabar on the west to Chilka on the east coast, and in Ceylon, grows to a good size and is one of the most relished fishes of the Malabar Coast.

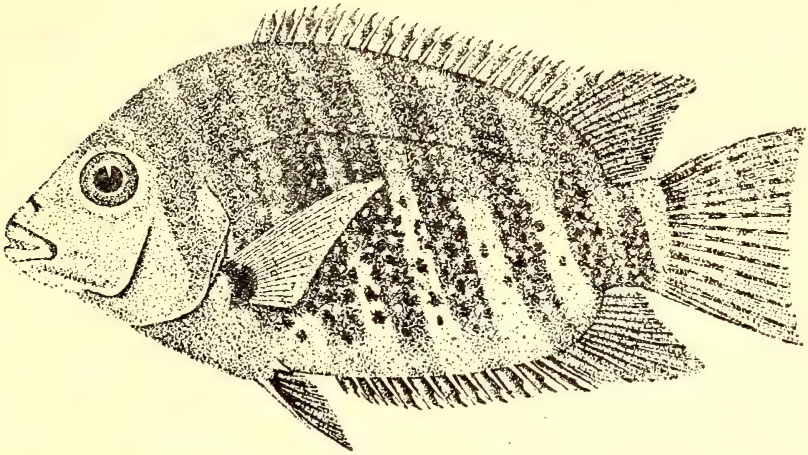


Fig. 1. The Pearl-spot, *Etroplus suratensis* (Bloch). (After Hornell).

The Madras Fisheries Department introduced the pearl-spot into the interior districts of Bellary and Anantapur and in the farms at Sunkesula (Kurnool) and Ippur (Nellore), where it has established itself.

Fingerlings of this fish have been transplanted successfully from North Kanara to the Mahim Creek in Bombay (Kulkarni, 1947) and in 1941 and subsequent years from Sunkesula, Madras, to the irrigation tanks of Baroda where they are reported to be breeding now (Moses, 1942 and 1944).

Fry from Madras have been introduced into the Bidyadhari area in Bengal (Jaganadham, 1946) and these have been reported to be breeding there (Job & Chacko, 1947). A total of 500 young fish were taken in 1942 from Madras to Hyderabad (Deccan) of which only a few survived. These commenced breeding in 1943 and the fish is now reported to have established itself there (Rahimullah, 1946).

This is perhaps the first or only Indian food-fish that has been transported to any foreign country. A consignment of pearl-spot was taken in 1922 from India to Mauritius via Colombo (Hornell, 1923). Over half of it reached safely, but it is not known whether the fish established itself there.

The Orange Chromide, *Etroplus maculatus* (Bloch): This cichlid, of more or less similar distribution and habitat as the pearl-spot, is of smaller size and hence is not of much economic importance. It is reared as an aquarium fish also and for this purpose has been introduced into several countries outside India.

The Orange Chromide has been introduced by the Madras Fisheries Department into the Sunkesula (Kurnool) Farm and from there transplanted by the Bombay Fisheries Department to the Bandra Creek (Bombay) where it figures regularly in the fishermen's catches (Kulkarni, 1947). It was successfully transplanted from Madras to the Hyderabad State in 1943.

The Murrel, *Ophicephalus* spp.: In several parts of India where major carps are not available and tanks are seasonal, the murrel forms a very important food fish. Kulkarni (1947) reports the transplantation of *Ophicephalus marulius* (Hamilton) from Poona to tanks in Bombay.

The Khorsula, *Mugil corsula* (Hamilton): Two trial transplantations of the mullet, *Mugil corsula* (Hamilton), from Bengal to Madras were made by Dr. T. J. Job in 1944 and by Dr. S. L. Hora in 1945 (Basu, 1946). The fingerlings reached the destination and grew well, but as their number was small the species has apparently not established itself.

INTRODUCED FOOD FISHES—Exotic

The Gourami, *Osphronemus goramy* (Lacèp.) (Fig. 2): The fish, a native of Indonesia, was first introduced in India during the early half of the last century and stocked in the Botanical Gardens at Calcutta, but the entire lot is reported to have perished by 1841 for want of proper attention (Thomas, 1881). Further details about this introduction are not available.

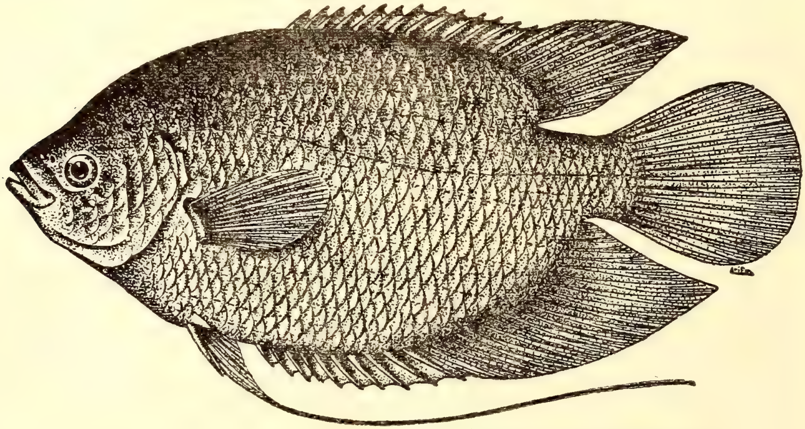

Osphronemus goramy Lac.

Fig. 2. The Gourami, *Osphronemus goramy* (Lacèp.). (After Hofstede)

About the year 1865, Sir William Denison, the then Governor of Madras, imported some gourami from Mauritius and introduced them in the Government House ponds at Madras while some were taken to the Nilgiris (Raj, 1916). The fish bred in the tanks at Madras and it appears that the fry were distributed to some of the tanks in the neighbourhood, including the Red Hills tank. However, the condition of the stock in general was not satisfactory and a fresh consignment of about

200 fish was brought from Mauritius and Java in 1916. The fish has established itself in various parts of Madras State, from where it has been successfully transplanted to Bombay in 1937 (Kulkarni, 1943 and 1946), Baroda in 1941 (Moses, 1944), Mysore in 1942 (Bhimachar, *et al*, 1944) and Cochin and Hyderabad in 1945. Gourami was introduced in the Punjab but could not survive the low winter temperature there (Khan, 1946).

The Tench, *Tinca tinca* (Bloch) (Fig. 3): The tench was brought from England by Mr. MacIvor about the year 1870 along with the golden carp and introduced into the Ootacamund lake (Molesworth & Bryant, 1921). The fish bred in the lake and subsequently fingerlings were transplanted to some more ponds and lakes in the Nilgiris and the Shevaroy Hills. Its introduction in the lower elevations does not appear to have met with much success though it is reported to have bred in the Sunkesula farm, Madras (Hornell, 1923 and Tampoe, 1929).

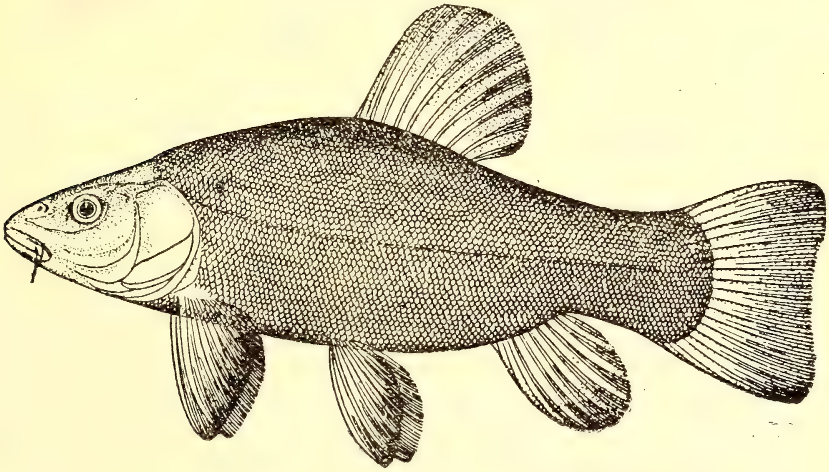


Fig. 3. The Tench, *Tinca tinca* (Bloch). (After Innes).

The Crucian Carp, *Carassius carassius* (Linn.): This fish, also known as the Golden Carp, is a native of Central Europe from where it has been transplanted to various countries. MacIvor introduced it about the year 1870 along with the Tench into the Ootacamund lake where it bred well (Molesworth & Bryant, 1921). Subsequently it was transplanted to several ponds and lakes in the Nilgiris, Shevaroys and Kodaikanal. Attempts to transplant this fish to the plains did not meet with success.

The Common Carp, *Cyprinus carpio* (Linn.) : Originally a native of China, this fish is now very widely distributed all over Europe, America and several other parts of the world. It was introduced in Ceylon from Prussia in 1914 and from there a consignment of 45 young fish was brought in 1939 by Dr. Sundara Raj, the then Director of Fisheries, Madras, and stocked in the Ootacamund lake where it thrived well and bred in three years. Three varieties of the common carp are distinguished, viz. the Mirror Carp (var. *specularis*) (Fig. 4), the Scale Carp (var.

communis) and the Leather Carp (var. *nudus*), and of these the first one is the most common.

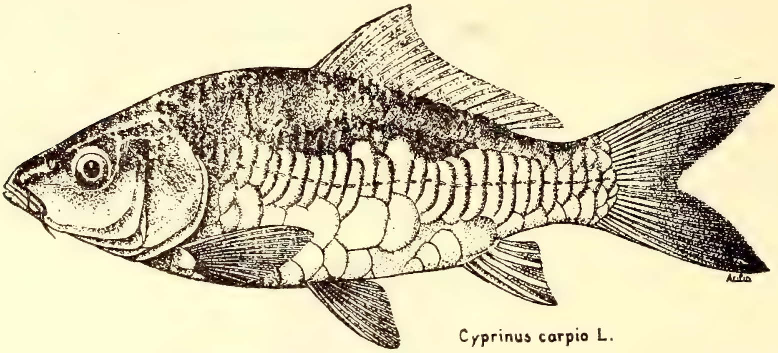

Cyprinus carpio L.

Fig. 4. The Mirror Carp, *Cyprinus carpio* Linn. (var. *specularis*). (After Hofstede).

The Mirror Carp has been transplanted to the Shevaroys where it is reported to be breeding (Ganapathi & Chacko, 1950). Though the fish grows well in the plains it has not bred there.

In 1946 some fingerlings of the Mirror Carp were introduced in the Ulsoor lake, Bangalore (Burton, 1948). In 1947 fingerlings of the fish were transported by plane in an oxygenated container from Ootacamund (Nilgiris) to Bhowali in the Kumaon Hills (U.P.) (Raj & Cornelius, 1947) and the fish is now reported to have bred there. A small consignment of fingerlings of Mirror Carp was also transported to Bombay in 1949, from Ootacamund, and introduced into a lake at Lonavla at an altitude of about 2,000 feet.*

TRANSPLANTED GAME FISHES—Autochthonous

The Putitor Mahseer, *Barbus* (*Tor*) *putitora* (Ham.): The large-scaled carps of the subgenus *Tor* are known as mahseers and are the favourite among Indian game fishes. The Putitor Mahseer is found all along the Himalayas from Kashmir to the Darjeeling hills and probably further east as far as China.

The lakes of Kumaon hills were stocked with this fish by Sir H. Ramsay about the year 1858 (Walker, 1888). The Bhimtal, the Nakuchiatal and the Sathtal were stocked with fingerlings transported in earthen vessels from the Gola river and the Nainital with those from the Koli river. The fish flourished in all the lakes except Bhimtal, where a second attempt was made by him in 1878, with success. The fish took well to the confined waters and bred in the shallow areas of the streams that drain into the lakes. Edye (1922) stocked the Khurpatal on the Nainital-Kaladhungi Road in 1922. Raj (1945) has dealt with the present condition of the mahseer in the Kumaon lakes in detail.

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* Annual Report of the Department of Fisheries, Bombay, 1948-49, p. 36.

The Khudree Mahseer, *Barbus* (*Tor*) *khudree* Sykes: Molesworth & Bryant (1921) have cited a report by Mr. Barlow to the effect that Pykara (Nilgiris) was stocked with mahseer before the introduction of trout. In the absence of further details it is to be presumed that the mahseer referred to is *B.* (*Tor*) *khudree* Sykes being the most common form found in that region at present.

Hornell (1923) reports about stocking the Kodaikanal waters (Palni Hills) with 162 mahseer fingerlings from the Tungabhadra in Kurnool. The species could either be *Barbus* (*Tor*) *khudree* Sykes or *B.* (*Tor*) *mussullah* Sykes, these being the mahseers available in the Tungabhadra. Information about the result of the transplantation is lacking.

INTRODUCED GAME FISHES—Exotic

Trout is the only exotic game fish introduced into India and at present two species have established themselves, viz. the Rainbow Trout, *Salmo gairdnerii* Rich. and the Brown Trout, *Salmo trutta fario* Linn., the former in the south and the latter in the north.

The introduction of trout in India was achieved by the efforts of the European residents in the country during the latter half of the 19th century and the beginning of this century. Though the work commenced as a private enterprise, it subsequently received the active support and cooperation of the Government. Details of the introduction of trout in India are given by Howell (1916), Mitchell (1918), Molesworth & Bryant (1921), Skene-Dhu (1906 and 1918), and Mackay (1945); and in the present account only some of the important events are mentioned. The Nilgiris and Travancore trout came from the same stock as the Ceylon trout regarding which Fowke (1938) gives valuable information.

Introduction of trout in the Nilgiris (Madras): The first attempt to introduce trout in India was made by Mr. H. S. Thomas in 1863, but the consignment of ova he was bringing perished on the way (Day 1876). In 1866 Day (op. cit.) imported 6,000 ova and though most of them died a few days after reaching Ootacamund, the few that survived turned out to be the first trout to see life in Indian waters. After a few years' lull, attempts were again made by Mr. McIvor in 1887 and subsequently by himself and others till 1906. Some of the attempts resulted in failure, others being partially successful. Most of the consignments were of *Salmo fario* but trials with *Salmo gairdnerii*, *Salmo levenensis* and *Salmo fontinalis* were also made. All the successive attempts proved futile till the first decade of this century.

The credit for the ultimate permanent establishment of the trout in the Nilgiris goes to Mr. Wilson who organized the whole work on a scientific basis. He found the climate at Dodabetta, where the hatchery was located, unsuited for the Brown Trout. So he constructed a hatchery at Avalanche and concentrated on the establishment of the Rainbow Trout. All the available stocks of brood fishes were transferred and fresh consignments of ova were brought from Germany and New Zealand, and fingerlings from Ceylon. The Avalanche hatchery was a great success and the Rainbow Trout is now well established in the Nilgiris waters.

Introduction of trout in Kashmir: The introduction of trout in Kashmir was carried out independent of the attempts that were in progress in the Nilgiris. The first shipment of ova was sent in the spring of 1900 as a present from the Duke of Bedford to the Maharaja of Kashmir in return for the Kashmir stags presented by the latter (Mitchell, 1918). The whole consignment, however, perished on the way on account of the heat. A second lot arrived in December of the same year and another followed in 1901. The ova were of Brown Trout and took very well to the Kashmir waters. Some ova liberated in the river Kalapani near Abbottabad flourished and bred there. A heavy flood in Kashmir in 1903 swept over all the brood ponds and hatcheries and this, instead of destroying the whole stock as was feared, resulted in providing more favourable conditions for their permanent establishment in the waters. Though both Rainbow Trout and Brown Trout were introduced, it was found that the latter is more suited to the cold Himalayan waters.

Introduction of trout in the Punjab: Trout was first introduced in the River Beas in the Kulu Valley (Punjab) in 1909 by Mr. Howell who brought about 23,000 eyed ova from Kashmir for the purpose (Howell, 1916). This stock established itself in the river and since then many lakhs of Brown Trout fry have been planted in the Beas and its tributaries and other streams in the Punjab (Tyson, 1941). The fish is now well established in Kulu and from there it has been transplanted to rivers and streams in Chamba, in the Kangra Valley and the Simla hills.

About 5,000 eyed ova of Rainbow Trout were introduced in Kulu waters from Kashmir in 1919. Though the fish spawned in 1922 and in subsequent years, it failed to give satisfactory results in view of its greater susceptibility to diseases than Brown Trout, and its culture therefore was abandoned (Khan, 1946).

Introduction of trout in the Kumaon lakes and in the Eastern Himalayas: Trout was first introduced in the lakes of the Kumoan hills in 1910 when a consignment of 10,000 ova was taken from Kashmir to the Bhowali hatchery, about 8 miles from Nainital. Another consignment was obtained in 1912 and fingerlings from these were stocked in various lakes such as the Nainital, Naguchiatal, Sathtal, Malwatal etc. (Skene-Dhu, 1918). Though the first stocking operations met with encouraging results it is doubtful if the trout has permanently established itself in the Kumaon hills.

Attempts made to establish trout in the Darjeeling Himalayas did not meet with success in view of the heavily silted condition of the rivers during floods and the precipitous nature of the valley with high waterfalls, whereas the fish has established itself in the Ha Valley in Bhutan at an elevation of 9,000 to 10,000 ft. (Hora, 1946). Further details about the above transplantations are not available.

Introduction of trout in Travancore, Kodaikanal and other waters in South India: The first consignment of trout ova for Travancore was obtained in 1909 from Howieton in Stirlingshire, Scotland (via Bombay) and this reached the High Range, Travancore, successfully. A second consignment was received in the same year via Colombo-Tuticorin, and another in 1913. All the above consignments comprised of ova of the Brown Trout. By this time culture of the Rainbow Trout was becoming a notable success in the Nilgiris and attention was turned to this species. Though the fry introduced into the waters of the High

Range showed phenomenal growth they failed to breed until a hatchery was located at Rajmally and the fish were liberated in the Eravikulam river, where they bred under natural conditions in 1937. Fresh stocks of Rainbow Trout were obtained from the Nilgiris and Ceylon and by 1941–42 the fish had firmly established itself in the High Range of Travancore. (Gopinath, 1942 and Mackay, 1945).

Streams in the Anamalais have been stocked with fingerlings of trout from the hatchery in the High Range, Travancore. The fish does not breed there due to the comparatively low elevation and consequent high temperature. As a result of the interest taken by Messrs. Crossley and MacTaggert two lots of trout ova were imported in 1894 by the Palni Game Association for stocking the Kodaikanal lake. Both the attempts resulted in failure (Skene-Dhu, 1906).

TRANSPLANTED LARVICIDAL FISHES—Autochthonous

Among the Indian larvicidal fishes, the cyprinodonts *Aplocheilus lineatus*, *A. panchax*, *A. blochii* and *Oryzias melastigma* (McCl.) are the most important; and these have been transplanted in several parts of the country for antimalarial work. Most of the transplantations are intra-regional and come under routine activities of public health departments of the States concerned, and the records are too numerous to be listed here.

INTRODUCED LARVICIDAL FISHES—Exotic

The Top Minnow, *Gambusia affinis* B. & G. (Fig. 5) : This fish from North America has been introduced in various countries for larvicidal purposes. It was first introduced in India by Dr. B. S. Rao and Dr. Chandrasekhriah who brought an experimental consignment to Mysore

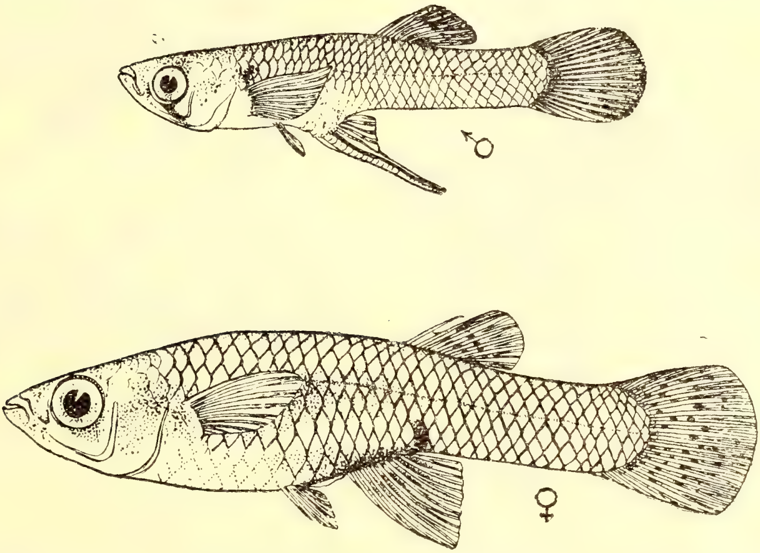

Fig. 5. The Top Minnow, *Gambusia affinis* (Baird and Girard). (After Prashad and Hora).

from Italy in 1928 (Gopinath, 1942). The attempt was a great success and the fish bred out of this stock was transplanted to several States, from Travancore in the south to the Punjab in the north. A consignment of young gambusia was brought from Ceylon in 1929 by the Madras Fisheries Department and stocked in the waters of Krusadai Island, and another was taken from Bangalore to Madras city in 1930 (Chacko, 1948). Both lots of gambusia bred well and have been distributed to different parts of the State.

The Millions : *Lebistes reticulatus* (Peters) : This is a native of South America and is known also as 'Barbados Millions'. A consignment was introduced by Major Selley into Madras in 1909, but was reported to have perished due to unsuitable climatic conditions (Prashad and Hora, 1936). However, in 1946 the fish was noticed thriving in the Rameswaram temple tank and from there it has now been successfully transplanted to various parts of Madras (Chacko, 1948).

Introduced Ornamental Fishes

Records are not available showing the exact period of introduction of ornamental fishes into the country, but it is probable that this might have taken place at a very early date during the Buddhist period when India and China came into intimate contact with each other. During the Moghul period fish ponds and ornamental pools were popular in palace gardens, and in the residences of the aristocracy.

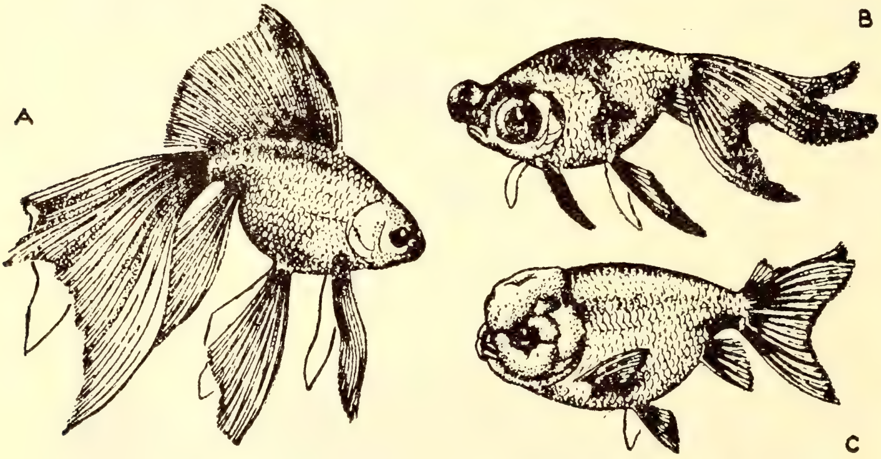

Fig. 6. The Gold Fish, *Carassius auratus* (Linn.) :
A. Veil-tailed variety ;
B. Pop-eyed variety ;
C. Lion-headed variety. (After Norman).

The commonest and the most popular ornamental fish is the Goldfish, *Carassius auratus*, introduced from China. Other examples are the Angel-fish, *Pterophyllum scalare*, from South America ; the Fighting-fish, *Betta pugnax*, from Siam ; the White Cloud Mountain Minnow, *Tanichthys albonubes*, from China ; the Black Tetra, *Gymnocorymbus* *ternetzi*, from Paraguay; the Flame Tetra, *Hyphessobrycon flammeus*, from Rio de Janeiro; the Pearl Gourami, *Trichogaster leeri*, from Siam; the Jewel Fish, *Hemichromis bimaculatus*, from Africa; the Chinese Paradise Fish, *Macropodus opercularis*, from China; the Red and Green Swordtail, *Xiphophorus hellerii*, from Mexico; the different colour varieties of Platies, *Platypoecilus maculatus*, from Mexico; the Liberty Mollies, *Mollienisia sphenops*, from Texas; the Cherry Barb, *Barbus titteya*, from Ceylon; the Negro Barb, *Barbus nigrofasciatus*, from Ceylon; and the Harlequin, *Rasbora heteromorpha*, from Sumatra and Singapore. Exact details about the introduction of these ornamental fishes are not available.

ACCIDENTAL TRANSPLANTATIONS

In the course of purposive introduction of species accidental introductions have also taken place, such as of *Rasbora daniconius* (Ham.) and *Oryzias melastigma* (McCl.) into the Andamans along with the fry of *Labeo rohita* (Ham.) (Mookerjee, 1935 and Herre, 1941). Species like *Ophicephalus gachua* (Ham.) found in the Andamans are considered to have been introduced accidentally by human agency (Mookerjee op. cit.). According to Annandale & Hora (1925), along with the fingerlings of *L. rohita* (Ham.) the fry of minor carps and certain Siluridae also might have been introduced into the Island.

As a result of the present fillip to the expansion of carp cultural activities in the different States (Job, 1951) and the consequent large-scale transportation of carp fry from the Gangetic and the Mahanadi systems of rivers to other parts of India there is a possibility of accidental transplantation of unwanted species.

GENERAL REMARKS

As will be seen from the foregoing account, several successful attempts have been made to introduce exotic species into the country and to transplant the indigenous ones. The advent of these exotic species does not appear to have in any way affected the indigenous fish fauna. Even the trout, the carnivorous habits of which are well known, has not been detrimental as it is restricted to the cool waters in the higher reaches of the rivers where economically important varieties of indigenous fishes are few. In Kashmir and in the Punjab, the trout waters still retain a rich indigenous fish fauna. However, this fact should not leave us unmindful of the dangers of indiscriminate transplantation. Strict quarantine restrictions have to be exercised while carrying out transplantation programmes. In view of the present food shortage the transplantation of food fishes like the major carps of India is of prime importance. The establishment of carps like catla in the Cauvery in the south and in the Bombay waters has been a creditable achievement, especially as it is a step towards regional self-sufficiency in the supply of carp fry for cultural operations. The result of the introduction of catla in Periyar lake in Travancore will be watched with interest and if the fish establishes itself in the Periyar system a suitable source of seed supply will be available for the region.

Among the fishes indigenous to India the pearl-spot ranks in importance next to the major carps in its suitability for transplantation and permanent establishment. The coastal districts of Orissa and Bengal appear to offer ideal conditions for introduction.

Another indigenous fish considered suitable is the Copper Mahseer, *Acrossochilus hexagonolepis* (McCl.). This fish grows to about 25 lb. and is distributed in the rivers of Assam and the eastern section of the Himalayas. Recently it has been reported from the Cauvery also. The fish breeds in semi-confined waters (Smith, 1944 and Hora, 1946) and its artificial propagation is reported to be easy (Ahmed, 1946 and 1948). Experimental transplantation of this could, therefore, be tried with advantage in waters where the major carps do not occur or when transplanted have failed to give satisfactory results. The small streams of the Andaman Islands appear to offer suitable conditions for the breeding of this fish, and it is likely that the Bengali settlers in the islands will find the Copper Mahseer a welcome substitute in the absence of the major carps.

The Tilapia, *Tilapia mossambica* (Peters) (Fig. 7) which is a native of South Africa, has given very encouraging results in some of the South-East Asian countries where it has been introduced in recent years. It will be desirable to consider the feasibility of introducing this fish in India also as an experimental measure.* The usefulness of *Trichogaster pectoralis* (Regan) (Fig. 8) for introduction in paddy-fields, swamps and marshes requires to be studied. This fish is a native of Siam and is now well established in several parts of Malaya and Indonesia.

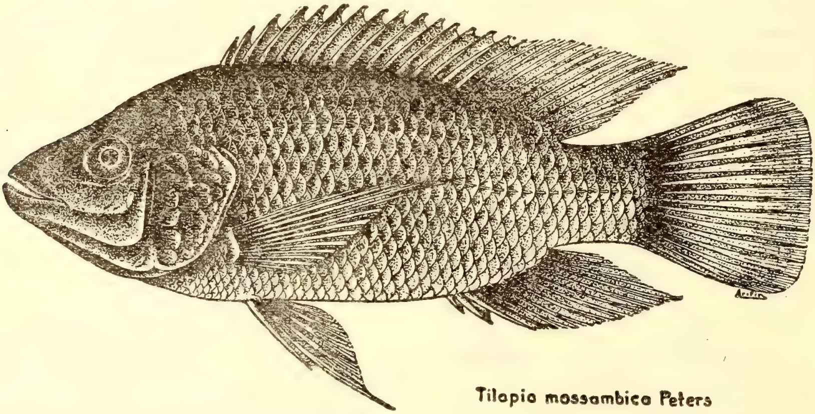

Fig. 7. The Tilapia, *Tilapia mossambica* Peters. (After Hofstede).

We have now in India a variety of fishes both indigenous and exotic suitable for culture in varying ecological conditions. The optimum

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*After this paper was read at the Symposium we were informed by Dr. Nazir Ahmed that a consignment of *Tilapia* had recently been brought to East Bengal (Pakistan). The results of this transplantation are awaited with interest. If the fish gets established in East Bengal, its natural spread into the contiguous areas of India will be only a matter of time.

requirements of the species concerned, their response to the change in habitat etc. have yet to be studied in detail. With regional self-sufficiency in crop and seed as the aim, judicious transplantation and introduction of these fishes have to be planned and carried out throughout the country.

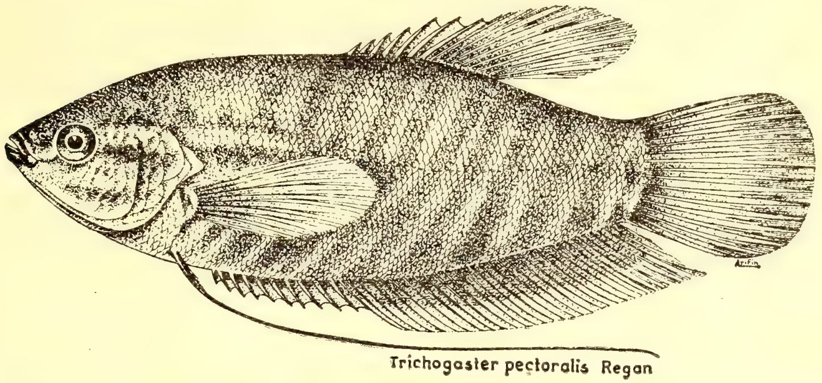

Fig. 8. The Sepat-Siam, *Trichogaster pectoralis* (Regan). (After Hofstede).

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THE POISONOUS & MEDICINAL PLANTS OF INDIA

BY

I. C. CHOPRA & L. D. KAPOOR

INTRODUCTION

Spread over an area of more than a million and a half square miles and endowed by nature with varied physical and climatological conditions, India possesses a rich and varied flora. Tropical plants grow in the south and south-east, while temperate and alpine plants thrive in the north and north-western Himalayas. The vegetation of these areas contains innumerable economic products, such as food plants, spices, oils, timber, fibre, gums, etc. There are more than 700 important food or fodder plants, among which about 200 species are valuable fodder grasses. In addition there grow in this vast subcontinent a large number of plants with active medicinal principles. More than 2,000 plants alleged to have medicinal properties have been enumerated in the literature of ancient India; of the plants listed in the British and other pharmacopoeias a very large proportion either grow here naturally or can be cultivated without much difficulty.

The more important families from which come useful medicinal plants are the following: Leguminosae, Compositae, Labiatae, Euphorbiaceae, Cucurbitaceae, Rosaceae, Gramineae, Liliaceae, Rutaceae, Ranunculaceae, Umbelliferae, Solanaceae and Apocynaceae.

Many of these plants have constituents, which if taken internally may cause serious disorders and even death; such plants are usually termed 'Poisonous Plants'. A large number of these, when taken in appropriate doses, are of help in the alleviation of suffering; but their toxic properties are such that in general such plants constitute a serious menace both to man and domestic animals. Recent studies in India have shown that we have about 700 species of poisonous plants belonging to 90 botanical families; their poisonous principles may be alkaloids, glucosides, toxalbumins, etc., which though useful and beneficial in small amounts, are actually harmful to our livestock.

The study of poisonous plants from their toxicological or economic aspects in relation to man is, therefore, very important. Many of these plants provide us with various medicinal principles which can be extracted and used in the country, or even exported to foreign parts. This is a study that promises well for the economy of India; under the auspices and financial assistance of the Indian Council of Medical Research much has been done here for the collection, extraction and application of active plant principles, as useful medicinal drugs. On the other hand, toxicological studies have not been sufficiently intense in our country; various countries in Europe and America are far ahead of us in this type of work, and it is only thanks to the interest taken by the Indian Council of Agricultural Research that India has awakened to the possibilities of this line of research.

WORK UNDER THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

In 1935 the Indian Council of Agricultural Research made a grant to Col. (Sir) R. N. Chopra for the purpose of starting intense work on Indian poisonous plants; soon the work started in the School of Tropical Medicine at Calcutta. The first results of Col. Chopra's activities was the publication of a list including about 700 plants that were reputed to be poisonous to man, livestock, fishes, etc.; this work entailed intense search for such plants both in the field and in the various national herbaria.

In the case of many of the plants listed by Chopra their poisonous properties had not been substantiated by actual experimentation. A preliminary chemical examination of the more important plants was carried out in the School of Tropical Medicine, Calcutta, and later on in the Drug Research Laboratory, Jammu & Kashmir State. The poisonous plants may be divided into two groups according to their toxicological properties:

(*a*) Plants poisonous to man and livestock.
(*b*) Plants poisonous to insects and fishes.

As far as the first group is concerned, there are still considerable gaps, but our knowledge is advancing satisfactorily; in connection with the second group our knowledge is still very meagre.

Loss of livestock due to poisoning

In India there are hundreds of plants intimately connected with the food supplies of roughly 180 million bovine and 80 million other livestock heads (sheep, goats, etc.). The fodder supply for this livestock amounts to at least 28 million maunds daily. Unfortunately there are no figures for the loss incurred through poisoning with fodder plants in this country, but they are believed to be very high. It may be interesting to refer to conditions existing in two states, Montana and Colorado, of U.S.A., which will give an idea of the possible damage. It has been calculated that the loss suffered in those two states through poisoning is of the order of 200 million dollars annually. This is a very large figure, considering the size of those states as compared with India (less than one-sixth), and also in view of the fact that the knowledge of poisonous plants is much more advanced in America, where active preventive measures are regularly taken to prevent such losses.

Food poisons

In the large majority of cases, poisoning is produced when plants are used as food. Cases of poisoning in animals through eating of poisonous plants are of frequent occurrence throughout the world and are even more common in India When such plants, which provide food and fodder for man and animals, produce toxic effects they are termed 'Food Poisons'. The following are some of the food poisons commonly met with in India. Several grasses especially juar (*Sorghum vulgare*) and baru (*Sorghum helepense*), mustards (species of *Brassica* and *Sinapis* especially the rai), several members of the Cucurbitaceae, leaf blades of Rhubarb (species of *Rheum*), the Potato family (Solanaceae), buckwheat

(*Fagopyrum esculentum, F. tartaricum*) and several species of *Rumex*, *Lupinus*, *Medicago*, *Beta*, *Quercus*, etc.

Poisonous grasses

Our knowledge of Indian grasses which produce poisoning is very meagre, and it is not possible to estimate the losses in livestock from this source. The problem of poisonous grasses is indeed of great economic importance in certain parts of India where the rains often fail and drought conditions prevail. The development of hydrocyanic acid among grasses in dangerously large quantities under definite climatic and soil conditions is very important in certain regions. It has been observed that such grasses are poisonous during wilting and under conditions of drought, that younger and more succulent ones are often more likely to contain lethal doses of hydrocyanic acid, but if well dried these plants are generally without poisonous effects.

Plants liable to produce dermatitis

Poisoning may also be produced through external contact as in the case of some species belonging to the genera *Rhus*, *Holigarna*, *Urtica*, etc., resulting in irritation of skin, eczema and dermatitis. A long list of such plants has been drawn up, but some of the important ones may be marked here:—*Abroma augusta* (Ulat kambal), *Arisaema speciosum* (Kiralu), *Euphorbia antiquorum* (Tridhera-sehund), *Excoecaria agallocha* (Gangwa), *Holigarna* sp. (Bibu), *Mucuna* sp. (Kiwach), *Schima wallichii* (Chilauni), *Tragia* sp. (Barkanta), *Urtica* sp. (Bichu), etc.

Insecticidal plants

The second group is composed of plants poisonous to insects and fishes and is also important in the economy of our nation. Insects do incalculable harm and are responsible for much loss of life and much destruction of foodstuffs and of property. On a moderate computation, the annual loss caused in India through insect pests has been estimated at 2,000 million rupees and over a million and a half in human lives. An effective control of these enemies of social and economic progress will reduce this enormous loss and will facilitate national development. One means of fighting them is by use of the insecticides which can be supplied by this group of plants.

In spite of the development of cheap synthetic insecticides such as D.D.T., etc., vegetable insecticides still hold a prominent place. The reason is that they are less deleterious to warm-blooded animals and plant life and many possess remarkable immediate knock-out effects. Among vegetable insecticides of proved value may be mentioned *Chrysanthemum* (Pyrethrum), *Derris* (Tuba root), *Nicotiana* (Tobacco), *Tephrosia* (Sarphankha), *Picrasma* (Charangi), *Delphinium* (Larkspur), etc., but there are many others which need investigation.

Pyrethrum (*Chrysanthemum cinerarifolium*) and Derris (*Derris elliptica*) have already acquired great importance as plant insecticides, and America alone imports several million dollars worth of these commodities. Pyrethrum is now grown in many countries for export, and Kenya and Japan are making enormous profits by its export.

In India its cultivation has been successfully started in Kashmir, the Nilgiris, Assam and other places. In Kashmir a large area was brought under this crop, and research work to improve the quality of pyrethrum flowers by proper selection of seed, collection of flowers at the right time, drying and storing under suitable conditions, was carried out by one of the authors and his co-workers. Unfortunately large scale cultivation for commercial purposes has nowhere been taken up in this country. In Kashmir a maximum production level of a hundred tons of flowers annually was reached, but lately on account of the disturbed conditions in 1947–48, production fell down to almost nothing. The plantations are again being revived, but it will take considerable time before previous levels are attained. *Derris elliptica* is found in a state of nature to a very limited extent in India, but several other species growing here need systematic investigation and cultivation for commercial exploitation.

Insect repellents

The insect repellents group of plants also occupy a prominent place in the economy of a nation. The cheaper and larger the number of effective insect repellents, the greater likelihood of the masses of India benefitting from their use. It is a time-honoured practice in India that the leaves of neem (*Azadirachta indica*) and patchouli (*Pogostemon heyneanus*) and the roots of costus (*Saussurea lappa*) are used to protect woollen fabrics from insects. Articles placed in boxes made of sandalwood (*Santalum album*) are immune from the attacks of these pests. Some essential oils such as eucalyptus oil (from *Eucalyptus globulus*) and citronella oil (from *Cymbopogon nardus*), when applied to the human body, give relief from the bites of mosquitoes and other insects so long as the odour lasts. Hemp (*Cannabis sativa*), if spread under a bedsheet, affords ample protection against fleas. The simple device of mixing leaves of *Trigonella foenumgraecum* (Methi) and *Vitex negundo* (Nirgundhi) with grains before storage saves them from insect attacks.

A long list of vegetable insecticides and insect repellents has been drawn up elsewhere. Many of these grow wild, and some are even cultivated in India. Mention may, however, be made of some of the more important plants in this respect: *Acorus calamus* (Bach), *Artemisia absinthium* (Afsantin), *Cimicifuga foetida* (Juinti), *Cinnamomum camphora* (Karpur), *Curcuma longa* (Haldi), *Delphinium* sp. (Larkspur), *Euphorbia* sp. (Hirvi), *Ocimum* sp. (Tulsi), *Peganum harmala* (Hurmal), *Santalum album* (Sandal), and *Zanthoxylum alatum* (Tejmal).

Piscicidal plants

It is a well-known fact that some plants are poisonous to fish. Cases are known where such plants have accidentally come into contact with water in ponds or streams and enormous numbers of fish have died as a result. Use of these plants for purposes of obtaining food is some times resorted to by people. This is uneconomical and wasteful, and the practice should be stopped. The list of plants poisonous to fish is a very long one. This group is also of importance as some of the insecticides are also piscicides and *vice versa*. A systematic investigation of the group may lead to the discovery of effective insecticides. Examples of important piscicides may be cited as:—*Albizzia* sp. (Siris), *Artemisia vulgaris* (Tithwan), *Berberis aristata* (Darhald), *Derris* sp.

(Tuba), *Dioscorea* sp. (Manalu), *Hydnocarpus* sp. (Kastal), *Juglans regia* (Akhrot), *Millettia piscidia*, *Phyllanthus urinaria* (Hazarmuni), *Rhododendron* sp. (Gaggar), *Strychnos* sp. (Kuchila), *Tephrosia* sp. (Sarapankha), *Verbascum thapsus* (Bantomaku), etc. etc.

Medicinal plants

It would be interesting to summarise briefly the salient features concerning the work on Indian medicinal plants which was initiated by Col. R. N. Chopra and his co-workers more than thirty years ago.

The work had the following main objects in view:—(*a*) To make India self-sufficient, by enabling her to utilise the drugs produced in the country by manufacturing them in a form suitable for administration. (*b*) To discover remedies from the claims of Ayurvedic, Tibbi and other indigenous sources suitable to be employed by the exponents of western medicine. (*c*) To discover means of affecting economy so that these remedies might fall within the means of the great masses in India, whose economic condition is low, and eventually (*d*) To prepare an Indian Pharmacopoeia.

Pharmacopoeial and allied drugs.

The work done in connection with medicinal plants has been responsible for bringing into use a large number of crude drugs used in the British and other Pharmacopoeias which were formerly imported from foreign countries by the pharmaceutical industry. It was shown that the active principles of many of the indigenous plants such as *Podophyllum*, Rhubarb, *Ephedra* and Indian Belladonna, etc. were up to the standards laid down in the pharmacopoeias. Similarly a large number of plants grow in India which, though not exactly the same, have properties and actions similar to the imported and often expensive drugs. These could form excellent substitutes. *Colchicum luteum* (Suranjan), *Picrorhiza kurrooa* (Kour), which grow wild in Kashmir and Himachal Pradesh have thus come into use as good Indian substitutes for the officinal variety of drugs *Colchicum autumnale* and *Gentiana lutea*. Indian Ephedra, Indian Belladonna, Aconites and Santonine have thus all found their way in the exports to U.K. and U.S.A. before and after the second World War. Many examples can be cited where Indian drugs, which otherwise perished unobserved in our forests, gained economic importance in the country.

The Drugs used in Indian Medicine

It is believed that out of the very large number of drugs used in Indian medicine there must be some at least which deserve the reputation they have earned as cures. A few plants may be cited for example:—Atis (*Aconitum heterophyllum*), Mamira (*Coptis teeta*), Anantamul (*Hemidesmus indicus*), Kurchi (*Holarrhena antidysenterica*), Maline (*Inula royleana*), Hurmal (*Peganum harmala*), Kuth (*Saussurea lappa*), Sarpagandha (*Rauwolfia serpentina*), etc. etc.

A large number of these commonly used drugs have been worked out by application of modern scientific methods. Their chemical composition has been determined, the pharmacological action of the active principles has been worked out by animal experimentation, and finally suitable preparations made from the drugs have been tested on patients in the hospitals. This laborious work has brought out the merit and qualities of certain drugs and it has been shown that they may prove to be valuable additions to the present armoury of the medical man to relieve the sufferings of humanity if brought into general use. But such drug plants unfortunately are not large in number. In many cases negative results have been obtained, which also is not without significance. There is an enormous field for investigation in this country but only the fringes of this vast problem have as yet been touched. It remains for future workers to explore and investigate the materia medica mentioned in the literature of indigenous medicine and to prove or disprove the effectiveness and practical utility of many alleged remedies mentioned therein. As Col. Chopra has said, 'At the present time when the big drug manufacturers of the world are producing an ever-increasing flow of synthetic remedies there has been a feeling in Europe and in America that medicinal herbs, particularly those used in the indigenous medicines of different countries, should receive more attention. Their use is built up on experience of generations extending over centuries at a price in human lives which is very difficult for any modern research to pay. From my own experience of thirty years I have no doubt that much remains to be learnt from a close study of such herbal remedies. Examples of such drugs are *Holarrhena antidysenterica* (in amoebioses), and *Rauwolfia serpentina* (in blood pressure) from India, *Stephania cepharantha* and *S. sasakii*, alkaloid cepharanthine (in tuberculosis) from Japan, *Ammi visnaga* (diuretic and coronary anti-spasmodic) from Egypt; *Coptis coinensia* (alkaloid berberine) has tuberculostatic activity; and a number of others whose efficiency have been recently established.'

He further observed that chemical investigation of plants has so far confined itself to the discovery of alkaloids, glucosides, etc. An enormous field, yet undetermined, is open to investigation, if plant research receives a new orientation and plant antibiotics are also studied. Recent work in India has shown the presence of substances of antibiotic nature in common Indian plants, e.g., *Moringa pterygosperma* (pterigosperimin), which are highly effective against disease producing organisms particularly of the bacillary dysentery group. Close collaboration in this type of work is pregnant with possibilities not only of scientific and academic interest, but also of very great practical economic importance to the country.

Indian pharmacopoeia

The fact that India should have an official publication which would record what she recognizes as a trustworthy and approved materia medica upon which can be established modern Food Drug Acts, Poison Laws, systems of legal medicine, need hardly be emphasized. But this involves not only the development of machinery for the administration of laws based upon official standards, but also finding an authoritative standard which every doctor and pharmacist in India will hail as real guide in everyday work. Production of such a work will entail a very large amount of work. The pharmacopoeia which is envisaged should include the composition of drugs, definite pharmacological action of their active constituents, well-established therapeutic uses, fully investigated toxicity and standard for a safe maximum dose based on chemical and biological standards. The work which was started by Colonel Chopra and his collaborators and which is now being done extensively by many workers in the country, is exactly the type of work which will lead to the preparation of an Indian pharmacopoeia. It is obvious, however, that much more will have to be accomplished before such an authoritative publication can be prepared. It is a matter of great satisfaction that a committee appointed by the Government of India with Colonel Chopra as its chairman has composed an Indian Pharmacopoeial list largely based on the scientific work done up till now. This list contains the indigenous drugs which have been sufficiently worked out on the above stated basis and will form in the first instance an Addendum to the Pharmacopoeias. This is the first step towards laying the foundation of the Indian pharmacopoeia and it is hoped that now, with independence achieved, an Indian pharmacopoeia will be prepared in course of a few years.

Drug research

With the opening of the Central Drug Research Institute at Lucknow, research on economic plants generally and medicinal plants particularly will be put on a sound, systematic and permanent basis. Colonel Chopra said in his address at the opening ceremony of this Institute: 'In spite of many handicaps, India's men of science have justified their capacity for original investigations and have taken an honourable and ever-increasing share in the advance of knowledge of pure and applied sciences. In fact progress in drug research has depended mainly on the contribution of a few individual workers rather than a systematic attack by concerted action. It is now recognised that a more systematic application of science and research, over a broader field, is essential in the national interest. Even during the short period of our independence, the concept of research which is rapidly developing is highly practical for country's needs. The deep interest and foresight of the Prime Minister and his able adviser, Dr. Bhatnagar, in giving generous grants for research, in spite of financial stringency, deserve the gratitude of the nation. Nothing can contribute more towards the rapid building up of a prosperous nation than wide research activities in science and its application. This problem is being solved by establishing National Laboratories of which a number are already functioning. Eminent men of science have taken up their direction. The work both on the side of pure science and its practical application should now make rapid strides. A new era has opened.' The Indian Council of Agricultural Research has played a great part in plant research particularly in connection with plant cultivation on a commercial scale. The whole country has been divided into a number of zones, and large grants are being given in connection with drug cultivation on scientific lines and thus increasing their contents of active principles.

Other plants of economic value

During the course of the survey undertaken by the authors under the guidance of Colonel Chopra, besides the plants yielding pharmacopoeial and allied drugs, many other plants having economic value were discovered and studied. For instance about 50 plants bearing essential oils, which are in demand both in the cosmetic and the pharmaceutical industry, were found growing wild in the State of Jammu and Kashmir. For convenience these plants are divided into three groups :

1. Plants whose essential oil content compares well with those grown in other countries, e.g., Mint, Lavender, Thyme, Sage, Angelica, (Chora) and Juniper (Padambij), etc. etc.

2. Plants not worked elsewhere, viz. *Inula racemosa* (Poshkar), *Skimmia laureola* (Nera), *Salvia* sp., *Herecleum* sp., *Prangos pubilaria* (Kornal) and *Senecio* sp., etc. etc.

3. Plants whose yield of essential oil is low but can be improved by artificial cultivation, viz. *Iris* sp., *Artemisia* sp., *Nepeta* sp., etc.

Preliminary work on the survey of essential oil bearing plants has been carried out. It is now for the industrialists to take up the initiative and to exploit the natural resources to the best advantage of the country. It is well known that in France in the region of the Maritime Alps a large industry for the production of scents and perfumes has been developed which supplies its produce all over the world. With our vast resources of these essential oil bearing plants a similar industry and on a much larger scale can be established which will be of great economic importance.

Cultivation of Medicinal and other plants

As has already been stated, India is an epitome of climates and an emporium of medicinal herbs. There is no reason why exotic medicinal plants should not thrive here under suitable conditions of soil, season and climate in different parts of the country. *Cinchona* and *Ipecacuanha*, which were introduced in the ninteenth century, are valuable drug plants under cultivation now. Pyrethrum, which is a potent source of vegetable insecticide, has also been successfully introduced in Kashmir, the Nilgiris and Assam. Investigations have been carried out in the Drug Research Laboratory, Kashmir, on the different problems concerned with the successful cultivation of pyrethrum with a view to the establishment of a large scale industry in this country. There is no reason why such an industry should not develop in the near future. Experimental work at different experimental centres was conducted in connection with cultivation of Lavender (*Lavandula officinalis*), Mint (*Mentha piperita*), Liquorice (*Glycyrrhiza glabra*), successfully and there is a great future for these and many others. Seeds of *Strophanthus Kombe* and *Duboisia myoporides* procured from South Africa and Australia respectively have been tried in different places in India. Many exotics can be introduced and those already growing can be extended for cultivation.

It may be concluded that the cultivation of medicinal, or rather economic plants, and the introduction of exotics has a promising future in this country and the work done so far has produced remarkable results. This should stimulate the governments of the various States to take the initiative and do this work in a systematic manner. The part played by the Indian Council of Agricultural Research in initiating and developing these studies has been of a pioneering nature; it is pregnant with the possibilities of future development and deserves the gratitude of the nation.

PHOTOGRAPHING THE WHITEBELLIED SEA-EAGLE

[*HALIAETUS LEUCOGASTER* (GMELIN)]

BY

WAN THO LOKE

(*With four plates*)

If I were asked what should be the tutelary bird of Singapore, I would without hesitation say, The Whitebellied Sea-eagle. This species is common here, although not numerous, because the skies of Singapore are not wide enough to accommodate a large bird with such a great flying range. Nevertheless, wherever you may be on this small, green and pleasant island there is always a good chance that you will see one of these magnificent birds. You will see him at any time of the year because he is a 'local-born' and lives and brings up his family in our midst.

I known of two nests which are regularly used, and no doubt there must be others. One of these nests is placed high up in an Albizzia tree in Malcolm Road; and the other, in a similar tree but placed even higher up (at 150 feet) finds itself in the very midst of big business, standing, as it does, in the compound of a house occupied by the manager of a well-known local bank. This latter nest was blown down in the big storm of 1950 but at the end of the year it was rebuilt and I was surprised to see that the new nest did not appear very much smaller than the previous structure.

Stuart Baker, writing of the Whitebellied Sea-eagle in 'Nidification of Birds of the Indian Empire' says: 'These Eagles select almost, if not quite, invariably only the largest trees upon which to construct their nests'. The Malayan birds are true to type in their behaviour in this respect. It is thus not surprising that no good photographs have ever been taken of the bird; certainly no such pictures, so far as I am aware, have ever been published.

Therefore, when His Excellency the Commissioner-General for the United Kingdom in South-East Asia, Mr. Malcolm MacDonald (himself a keen and knowledgeable ornithologist) telephoned me at the end of 1948 to say that he had found a nest of the Eagle in his garden at Bukit Serene, a wild thought struck me: why not build a machan up to it and try and photograph the birds?

An exploratory trip to Bukit Serene disclosed that the nest was placed at the very top of an enormous jungle tree (*Dipterocarpus grandiflorus*). We estimated that a tower 100 ft. high would reach it, but first of all we had to make sure that the bird we had seen sitting in the nest was in fact incubating. One of the Tamil workmen, employed by the contractor who was going to construct the tower for us, volunteered to climb the nest-tree and make the necessary investigation. A couple of evenings later this lone and brave scout was sent up on his mission, armed only with a slender piece of rope which he attached to his two feet. The bole of the tree was smooth and without side-branches until

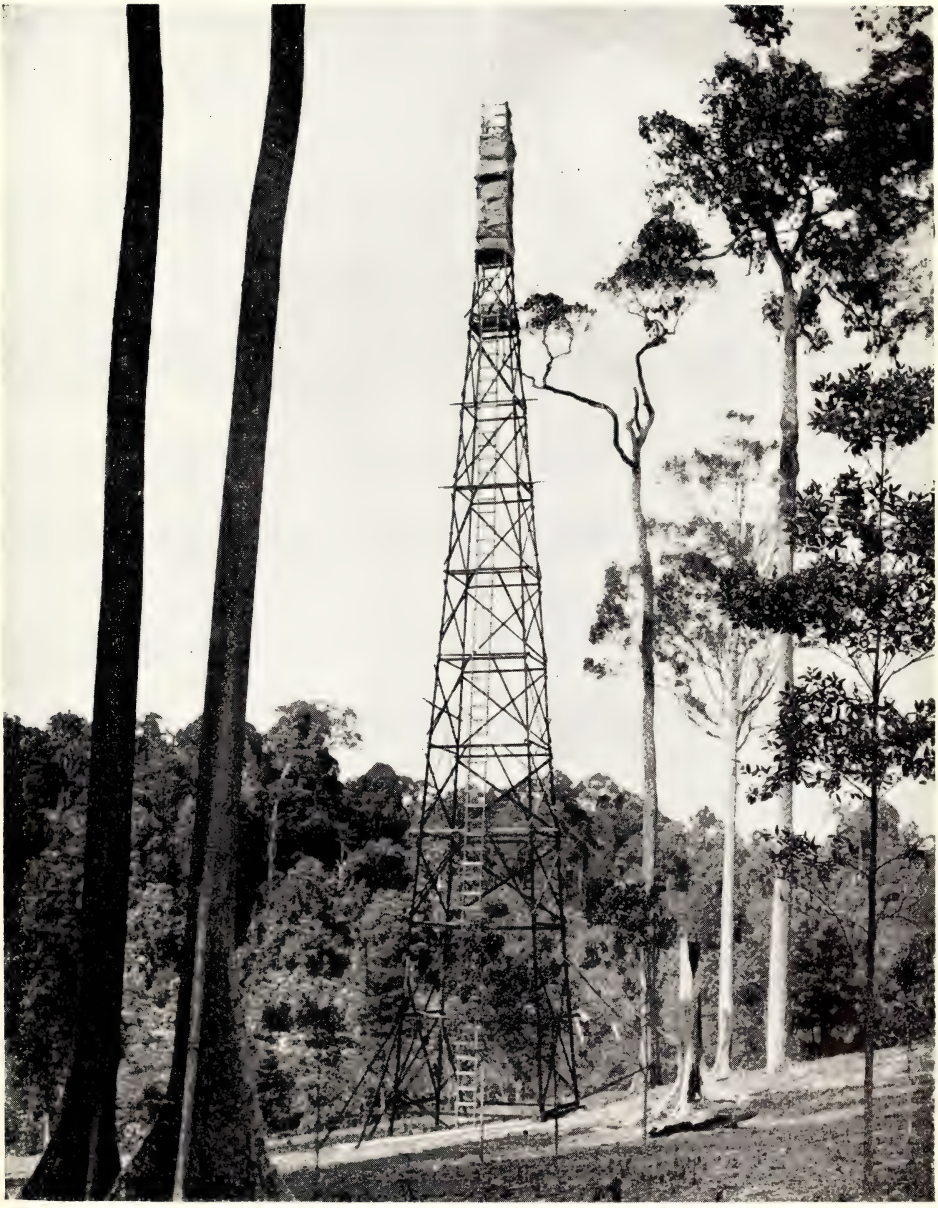


Photo *Author*

The photographing tower, 130 ft. high.

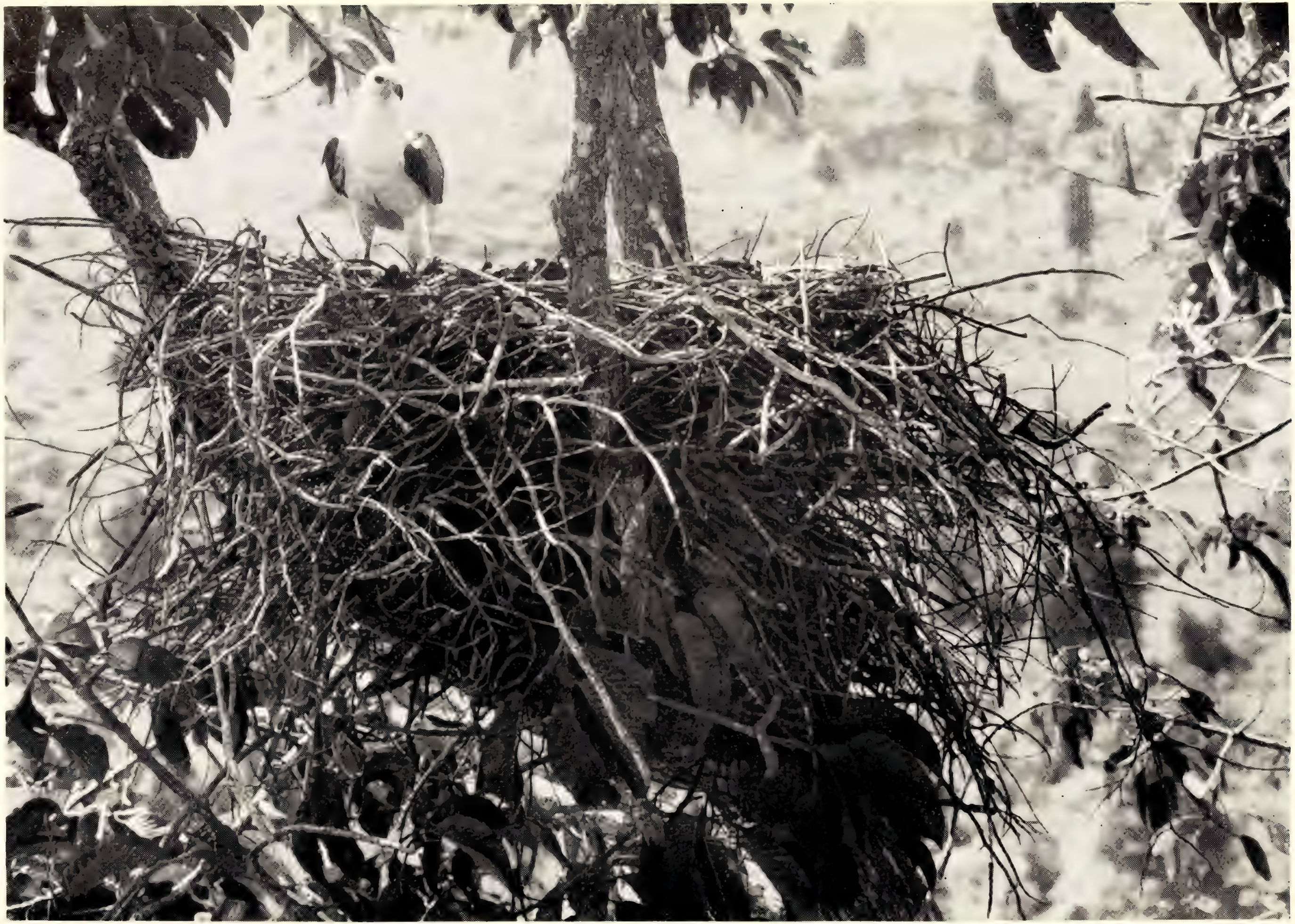


Photo *Author*

Whitebellied Sea-eagle at nest
(Note proportions of bird and nest).

it reached the nest. All went well for a time and our climber moved steadily upwards. When he was about three-quarters of the way up he suddenly let out a yell and began coming down so fast that he practically fell the last twenty feet. His head, face, arms, and back were covered with little dark objects which made the poor fellow look like a currant cake. We had reckoned without the enemy, a swarm of little black bees which had their abode inside a small hole in the trunk of the tree and formed most effective guardians of the Eagles' nest. We rushed to our poor scout's rescue, swatted and picked off the bees and then drove him quickly back to Singapore for medical treatment. Fortunately, the poor man recovered quickly.

This preliminary setback forced us to the conclusion that careful watching through binoculars would be the only means of settling our problem. Observations confirmed that the bird was brooding and I thought I once saw the bird bend down and make movements as though it was turning over an egg. The decision was then taken to build a tower.

The nest-tree stood on the side of a hill. We were afraid that projecting branches would prevent a good view of the nest from the upper side of the hill and so it was reluctantly decided to place the tower on the lower slope of the hill, despite the fact that a taller structure would in consequence be needed.

Construction of a 100-foot wooden tower began: first the timbers were prepared and cut; then the tower was assembled in the contractor's workshop to make sure that all the pieces fitted together properly; finally the tower was dismantled and the entire structure taken out by lorry to Johore, 19 miles away.

Assembling of the tower on the site began on February 8th, 1949. The workmen were allowed to work for only two hours a day, for fear of disturbing the birds. Progress was slow but finally, on February 20th, the tower was completed. But alas! it was not high enough. We were some 20 feet short of our goal. The workmen said they could nail on a superstructure, and argued that as they were prepared to build it I should not be afraid to sit on it. So, the crazy work went on.

The additions were completed on the 27th, and I was asked to inspect the finished job. To my horror I saw that the bit which had been tacked on was quite evidently out of plumb but as the contractor's manager and his workmen were watching expectantly and showing the very greatest interest, I climbed up even though my heart was in my mouth and lead was in my boots. Later, I learned that the interest shown had more point to it than I had guessed; some of the workmen, having less faith in me than I was supposed to have in their work, had betted that I would never get to the top.

The Eagle, quite unperturbed by our presence below, did not fly off the nest until I was half-way up the ladder. At the top I was disappointed to find that the tower was still not high enough to allow of a sight of the contents of the nest. Later on, when familiarity had bred a measure of contempt, we added yet a little more to the tower and were rewarded with the sight of a single, not very white, egg.

The final height of the tower was, in all, about 130 feet. It was held upright by a number of wire cables, attached either to nearby trees or to stakes in the ground. When the tower was eventually taken down, we found that the base was sunk only 18 inches into the ground. I recalled then the remark Mrs. MacDonald had one day made to me jokingly, but only half in jest, 'If anything happens to my husband when these crazy things are going on, I shall have to blame you'. H. E. went up daily and sometimes twice a day, watching and keeping careful notes. The remembrance of it all now makes me think of a story which Mr. Sálim Ali sometimes tells concerning the manager of a wolfram mine in Burma who had been given the job of showing the Governor round. His superiors, realising that the manager's vocabulary was of a rough and ready and somewhat limited nature, cautioned him to mind his language. All went well until they suddenly reached a low point in the tunnel. The manager, in his excitement and anxiety to protect his distinguished visitor, grabbed the Governor by the shoulder and said in a loud voice: 'Mind your bloody head, Sir'. Mr. MacDonald, however, is a very courageous and adventurous man, so perhaps even the most forceful language would not have succeeded in keeping him on the ground.

Observations and photographic activity in the hide extended over a period of about 6 weeks. Every weekend, and such hours as I was able to seize during the working week, were spent on the top of the tower. The distance from my office to Bukit Serene involved a journey of about 20 miles, so that those early afternoon disappearances must have been regarded by my staff with more than a little suspicion.

Both birds incubated the single egg, but one bird—the less shy of the two—did the major portion of this work. It was possible, after a while, to tell the birds apart, not only from the differences in their behaviour but also from their size; the shyer bird was also the smaller of the two and this I took to be the male. He rarely came to the nest, but was often to be heard as he flew round in the sky above, or, perched on some high vantage point on a distant jungle tree, uttered his loud, clear, and curlew-like call. Any suspicious movement under the nest-tree was always signalled to his sitting mate. I could tell if the male was flying overhead because the hen would cock an eye toward the heavens with that kind of questioning look which wives reserve for husbands when they come home from a stag party. Once, when I had been sitting in the hide for some time watching the brooding female and, as usual expecting nothing much to happen but hoping nevertheless that something would, the male bird came flying high in from the sea, uttering a loud, insistent call. His mate answered and immediately flew off the nest to meet him and together, uttering their wild duet, they flew round in great circles with only an occasional flap of their huge pinions. She returned to the nest some time later, but whether the male had brought her breakfast as well as inviting her to a morning flight, I shall never know because they were too far away for me to see what they were doing and she brought no food back with her. In fact, I never saw the birds bringing anything to the nest, except on one occasion when a large branch, still with green leaves on it, was brought to add a little crude decoration to an already huge structure.

The birds invariably approached the nest from one direction only. Even in the calmest weather, the loud thud made by the bird as it landed on the nest could be heard 40 feet away. This observation of

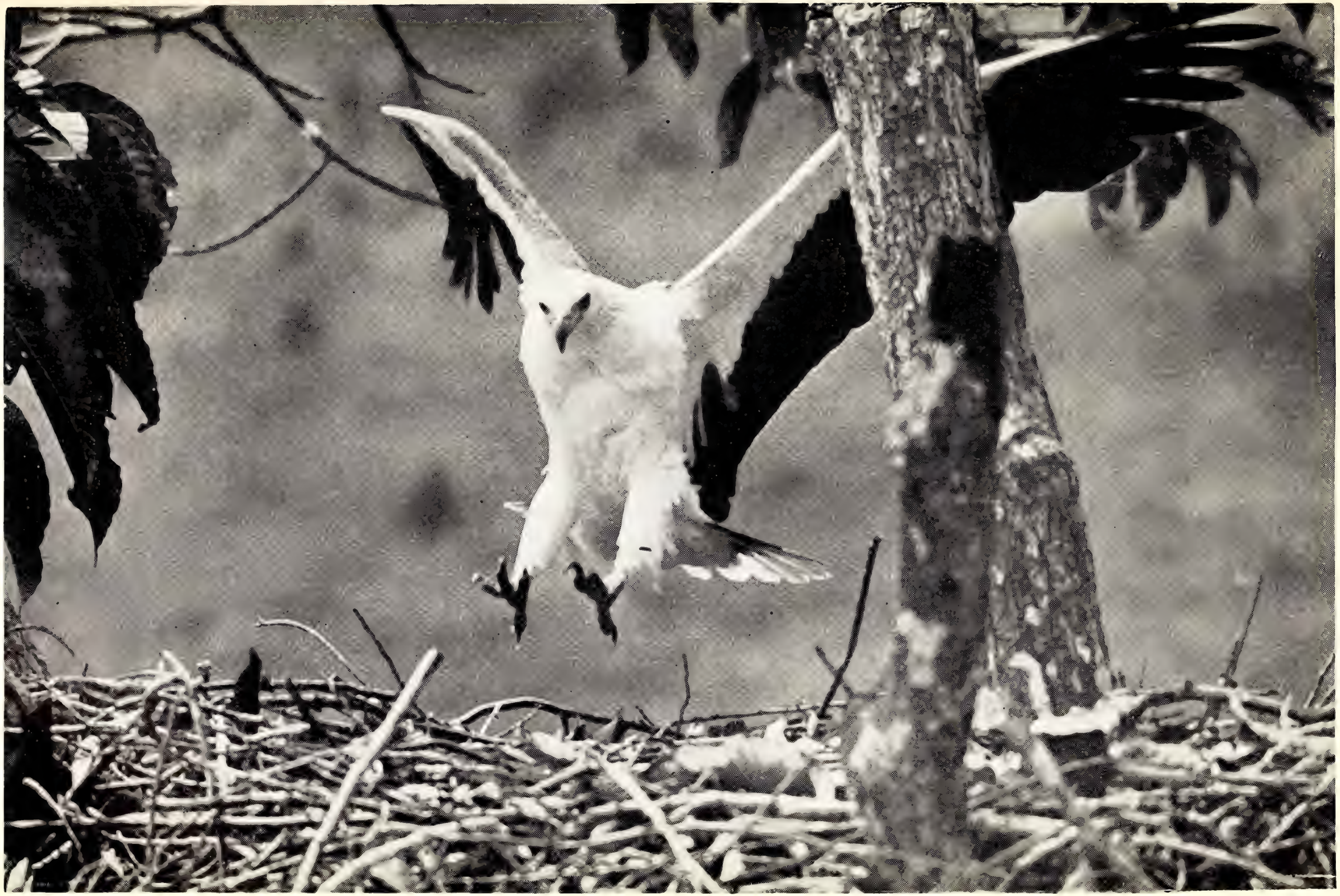


Photo *Author*

Bird arriving at nest.

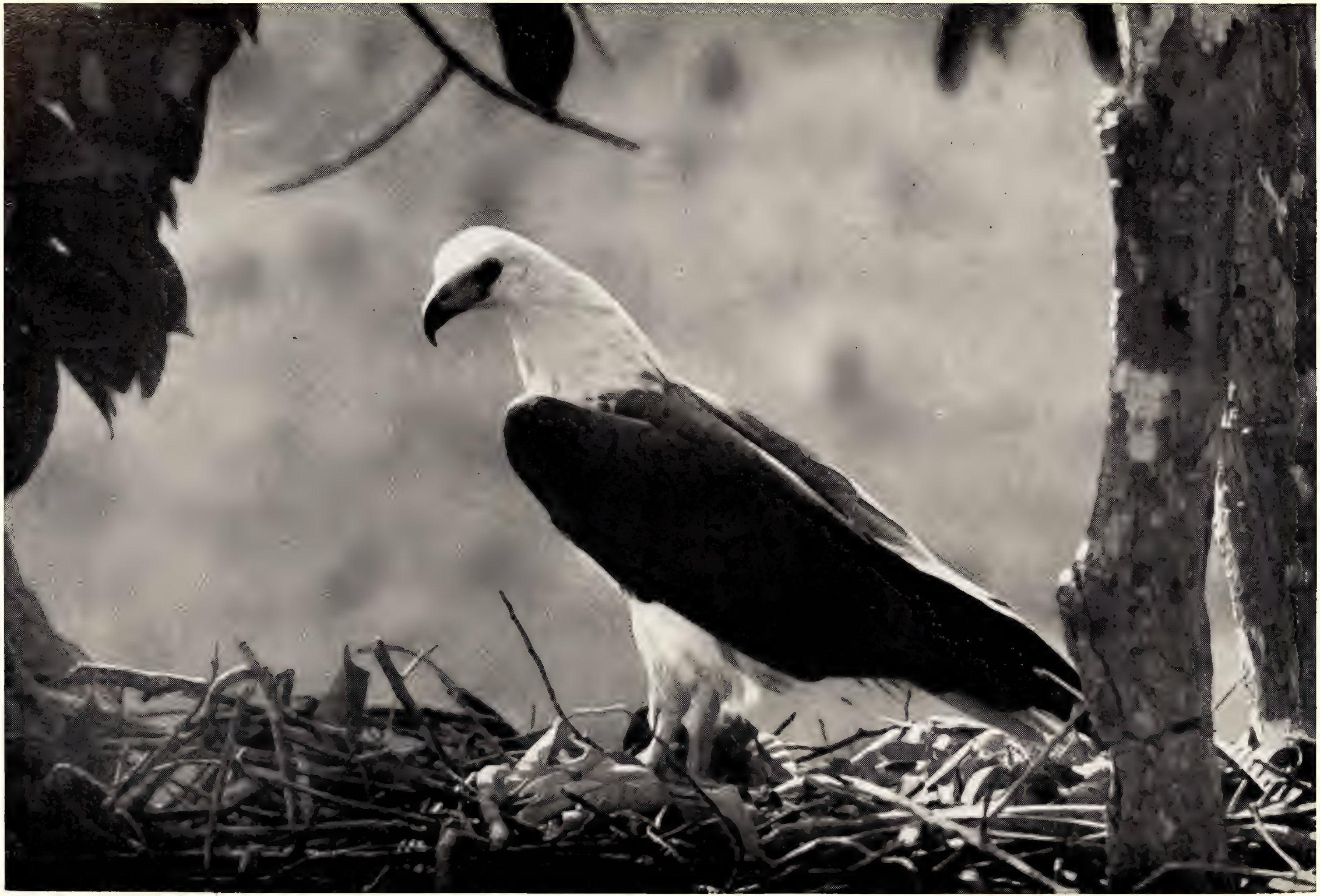


Photo *Author*

Suspicion.

the one-way traffic rule allowed me to get the photograph of the flying bird which is reproduced in Plate III. With a 14 inch telephoto lens on the camera and a shutter speed of 1/1000 sec., the diaphragm had to be used fully open thus giving me practically no depth of focus. Added to this difficulty there was the problem of the rapid approach of the bird which necessitated the release of the shutter a fraction of a second before the bird reached the spot on which the camera was focussed. As this spot was placed out in space, I was compelled to gauge its correct position by focussing the camera on a leaf of the tree which, it was judged, was the correct distance away. The reader will thus not be surprised to hear that I had a long string of failures before finally securing the desired picture on the very last pack which I was to take of the bird.

On one occasion, the bird approached from a different direction and landed on the nest from the right-hand side. I got a photograph of it as it touched down. Wind currents must have been unfavourable because the picture shows an off-level landing with the bird pushing down hard with its left wing in order to correct its balance; the displacement of air caused by the pressure of the wing is clearly seen in the photograph as it has ruffled the breast feathers.

Bird photographers sometimes suffer from an inability to gauge the strength of the light because of the continual application of a single eye to a hole in the hide. The same problem confronted me in this case also, but on days of flying cloud I was always able to judge the strength of the sun by the sharpness of the shadows cast on the ground by the surrounding jungle trees; I could see these shadows merely by looking downwards between my legs. An exposure meter reading was also easy to obtain because one had only to direct the instrument in an earthward direction.

Three planks formed the floor of the topmost storey of the hide and when the ¼-plate Graflex camera and tripod were in place there was not much room left for the photographer. I found, however, that I could make quite a comfortable morning of it by sitting cross-legged, in Buddha-like pose, on the free portion of the floor. One's body only began to protest after the end of 2½ to 3 hours of this kind of squatting. Five hours was the longest continuous period I ever spent in the hide.

A storm blew up one day and bore down on the hide from the north. I decided to sit it out and watch the effect of the rain and wind on the brooding eagle. But when the wind freshened the tower shook alarmingly and the cloth of the hide cracked like a whip so that, after enduring a few minutes of this warfare of nerves, I packed up my equipment and beat a hasty retreat, discarding my good intentions with the practised ease of a habitual maker of New Year resolutions.

We had hoped that, having found the eagle at so early a stage of its breeding, we would be rewarded with a series of egg-to-fledgling pictures, but in bird photography one soon learns that the best laid schemes 'gang eft agley' and so it proved in this case also. After a period of at least six weeks, when no little eagle had emerged from the egg, we began to suspect the worst. (There is reason to believe that a high percentage of the eggs of the sea-eagle are addled.) The object of our attention continued as lifeless as if it had been made of

China and so, one day, quite abruptly, the eagle decided that it had had quite enough of sitting in its nest and looking at us (just as we were beginning to get equally tired of sitting on our tower and looking at the eagle) and apparently kicking the egg over the side of the nest, it flew away, never to return: I say 'apparently' because no one saw the egg being ejected although Mr. MacDonald found broken pieces under the tree.

I have always been sorry that things did not turn out better so that I could have ended up with a complete series of pictures. Although neither Mr. MacDonald nor I have ever said as much to each other, speaking for myself alone, I must admit that I was relieved to find the pole-sitting come to an end. The photographs taken of the birds have had a good deal of success in exhibitions, and I daresay if the opportunity of photographing a nest with young in it were ever again offered, I should soon find excuses for building another tower.

ON THE TRAIL OF THE KOUPREY OR INDO-CHINESE FOREST OX (*BIBOS SAUVELI*)

BY

Dr. Boonsong Lekagul

Bangkok (Thailand)

(*With three plates and two text figures*)

In 1944 I saw a pair of horns of a strange wild ox in a shop selling Chinese herbs as medicine in Bangkok. These were unfamiliar to me since they did not belong to the gaur, banteng, buffalo or gayal which are known to exist in this part of the world.

The horns were about the size of a banteng's, but curved in a curious manner. About 13 inches from the tip the surface covering was split, forming a collar of long shredded strips around each horn. These strips were 0.2 to 0.3 inches wide and 4 to 8 inches long. The distance between the bases of the two horns was only 3½ inches and the forehead was slightly convex, not concave as in the banteng or the gaur. I purchased this pair and enquired of many of my friends, but could get no information about them.

Towards the end of the same year I found two more similar pairs of horns in a Chinese pawn shop. These two were smaller in size, rather flat, and curved like those of the Lesser Koodoo of Africa. The distance between the horns at the base was about 3 inches and the frontal bones were also not concave. This led me to believe that these belonged to cows, and the first pair to a bull, of some unknown species.

After enquiries of many hunters and naturalists in Siam I finally learned from an old gentleman, Phra Abhai Vongse, who had lived in Cambodia in his youth, that these were the horns of a kind of wild ox called by the Cambodians 'Kouprey' (wild ox) and by the Lao people 'Vua Ba'. The animals were apparently plentiful in the jungles of north-eastern Cambodia where he had hunted them about 20 years ago near Chongkal, but without success.

In January 1945 I led an expedition to northern Cambodia in search of these animals. We started from Kralann (or Phibul Songkram) going up north passing the villages of Ban Mong, Srae Parang, Talok, Varin, Srae Noi, Lavia, Tapeng-Sang Kae, Srae Kandal (Sarong Sangkae), Tapeng and Prey Weng. Some photographs of the three pairs of horns mentioned above were taken along with us and we made enquiries in the villages on the way. During the first fortnight we met no one who knew anything about these animals, but after travelling about 200 kilometres we came to a village called Prey Weng where we got the first information of their occurrence from an old hunter. He claimed to have hunted them often and stated that they could be found in the forests of Tapeng Chook and Phrom Dhep further north and eastwards. Having spent two weeks collecting this information we ran short of rice, being unable to get sufficient quantities from the villages around. We, nevertheless, decided to proceed with our expedition living largely on the meat of wild animals.

About a day's walk from Prey Weng we reached the Tapeng Chook which was an open forest on flat rolling hills. Here we found the first definite signs of Kouprey in the form of old footprints. They were mixed with banteng tracks. The local hunters could distinguish the Kouprey tracks without hesitation as they were longer and blunter in front. The tracks were however several months old having been made during the last rainy season.

Many herds of banteng were found feeding on the plains and we also saw many Thamin or Brow-antlered deer (*Panolia eldi*). Two fine bull banteng were shot mainly for meat. After 5 days we were compelled, by the scarcity of rice, to move further to a village called Anlongpoom. Here too only very small quantities of rice were available, the local people having to live on roots dug out from the neighbouring forests.

At Anlongpoom we were again unlucky with Kouprey though we saw many new tracks. Two bull banteng and a thamin were shot. The former, which are not much hunted here, feed and stay almost the whole day in the plains and in the open forest. These habits are quite different from those found in Siam.

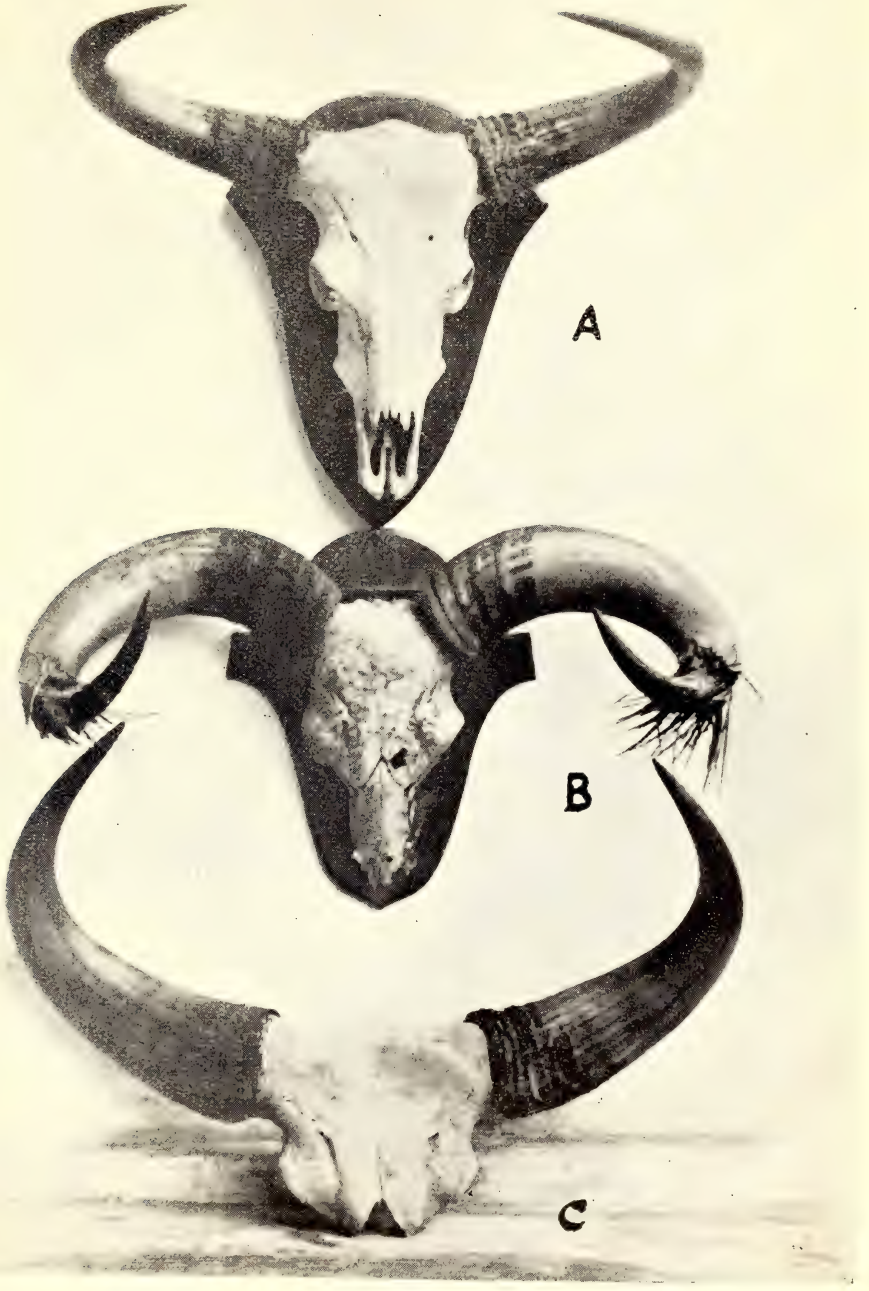
After three days at Anlongpoom we moved to a forest called Kabal Kamode meaning 'Corpse Skull'. There being no village here, we camped near a pond. Fresh tracks of Kouprey and other large animals were numerous, and on the first morning my companion Mr. Poon Pan followed up the fresh tracks of two bull Kouprey which were keeping together. He came up to them at about nine in the morning while they were still feeding in the open forest. He noted that both the bulls were grey which turned dark in certain areas e.g. in front of the shoulder, on the neck and face. He did not observe any brown at all. He noticed their long and hanging dewlap. Near the tips of the horns of both of the animals were big 'collars' formed of shredded strips and brushy in appearance.

A bull dropped to his first shot, but repeated misfires due to old ammunition obtained during the war permitted it to stagger away.

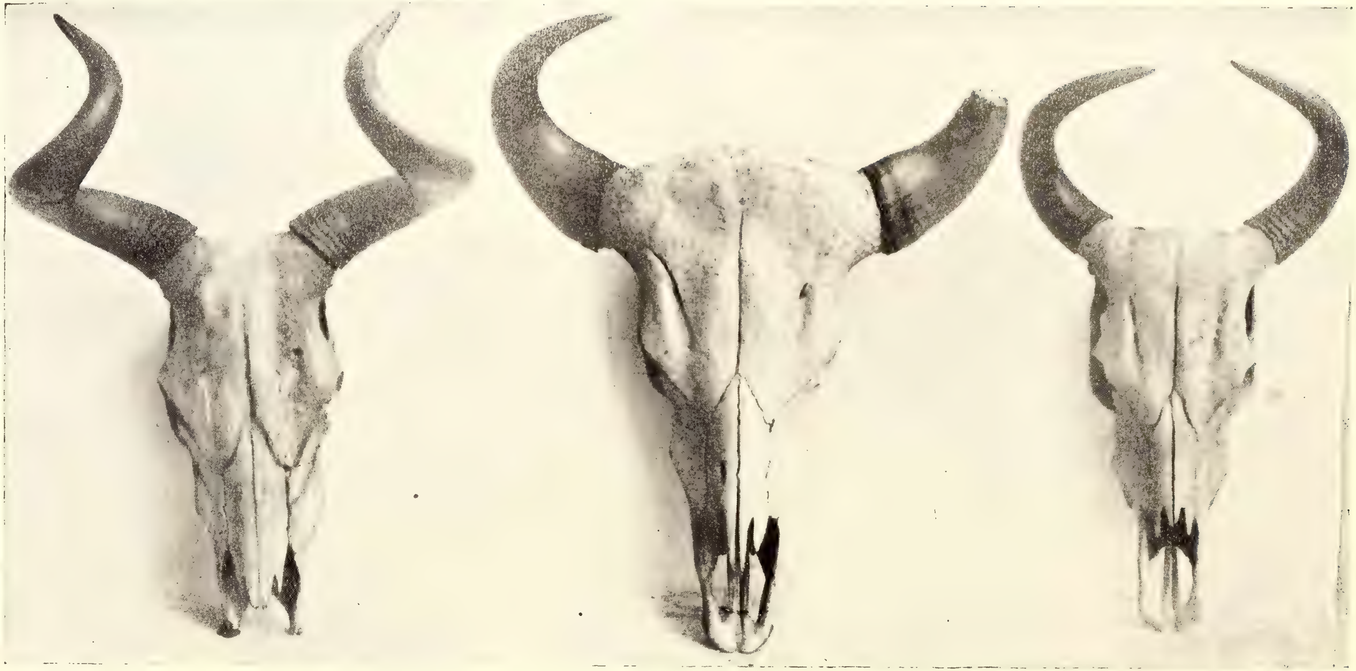
Poon Pan came back to camp and we both went out and followed the wounded animal until dusk, and though we found a few pools of blood where it had lain down we were unable to catch up with it. We stayed here for 3 days, but only got two bull bantengs.

From Kabal Kamode we travelled eastward to Koh Ke or Prasat Yai and Phra Abhai alone saw six herds of banteng. At Koh Ke there was a pyramid-like monument or chedi with several storeys, and a big ancient palace nearby. Not far from the wall of this palace I found a large herd of banteng and bagged a big bull with fine horns. As there were no tracks of Kouprey we moved the next morning to Tapeng Ra Vieng. Here we found new tracks of Kouprey and also wild buffalo, banteng, gaur and wild elephant. We followed the Kouprey tracks for 5 days, but the ground was too dry for success.

One day at about noon Mr. Poon Pan and his guide were resting under the shade of a tree near a pool. A herd of four Kouprey passed



A. BANTENG ♂ B. KOUPREY ♂ C. GAUR ♂



Photos *Author*

KOUPREY ♀ GAUR ♀ BANTENG ♀

nearby, but scenting them they made off at a slow trot. Poon Pan upon hearing them ran after the herd; being unable to approach the big bull which was running in front, he shot the last animal which turned out to be a fine cow.

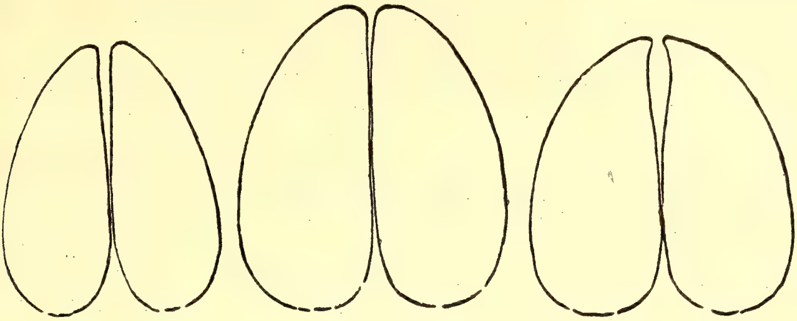


FIG. 1

KOUPREY GAUR BANTENG

Spoor of Bulls.

When I heard this good news, I hurried to the spot and arrived there at dusk taking such pictures as the light permitted. The whole body was greyish-white, lighter on the abdomen but darker in front of the forelegs, at the neck and on the face below the level of the eyes. It had also white stockings on its feet which, however, did not contrast strongly with the grey of the body. It had a well defined dewlap, though not as long as in a bull. It had also long white hairs inside its ears. The dorsal ridge was not as high as in the gaur and terminated in the middle of its back as in the banteng. There was no white patch on the buttocks. The horns were twisted as shown in the picture. There was no horny shield between the bases of the horns as in a bull banteng. Its nose was peculiarly notched. The tail was longer and bushier than that of either gaur or banteng. I obtained the body measurements, but unfortunately I have lost them. Speaking from memory, it was about the same height as a gaur and banteng, but the body was not so thick being flatter on both sides, the presence of the long dewlap accentuating this effect. The animal looked leggier than the banteng.

On the following morning I came upon a small herd of Kouprey feeding in open forest. My guide saw them first when they were about 200 yards from us and whispered 'Kou! Kou!' pointing to them with his hand. It took me some time to pick them out as their colour at this distance looked like a greyish fog. In this herd I saw a calf about 3 feet high, greyish white all over without any brown as in a young gaur. Having already shot a cow, we were looking for a bull, but this herd consisted only of three cows and the calf.

As far as I could observe while following up their tracks, they appeared to feed and rest on the open plain and in open forest avoiding densely wooded areas unless very much disturbed by men. They lived in herds sometime numbering twenty or more. There were also solitaries as in the gaur and banteng. They appeared to be fierce animals butting at objects in their way—sometimes even at the stumps of trees or an ant hill—a stump about the thickness of a man's arm being broken in two and thrown some distance.

While following a herd which had not been shot at, I found some drops of blood which might have resulted due to fighting within the herd.

Distribution.—I found the Kouprey in the country between Chongkal and Melonprey and the Dongrag range on the border between Cambodia and Siam. I also learnt from Prince Petcharaj, a Lao prince, that he had hunted them west of Kratie, southwest of Stung Tren, Voeung Sai, Pakse and Saravane. The northernmost place where he had found the Kouprey was Se Bang Nuan River, a little north of Saravane, but not beyond the river.

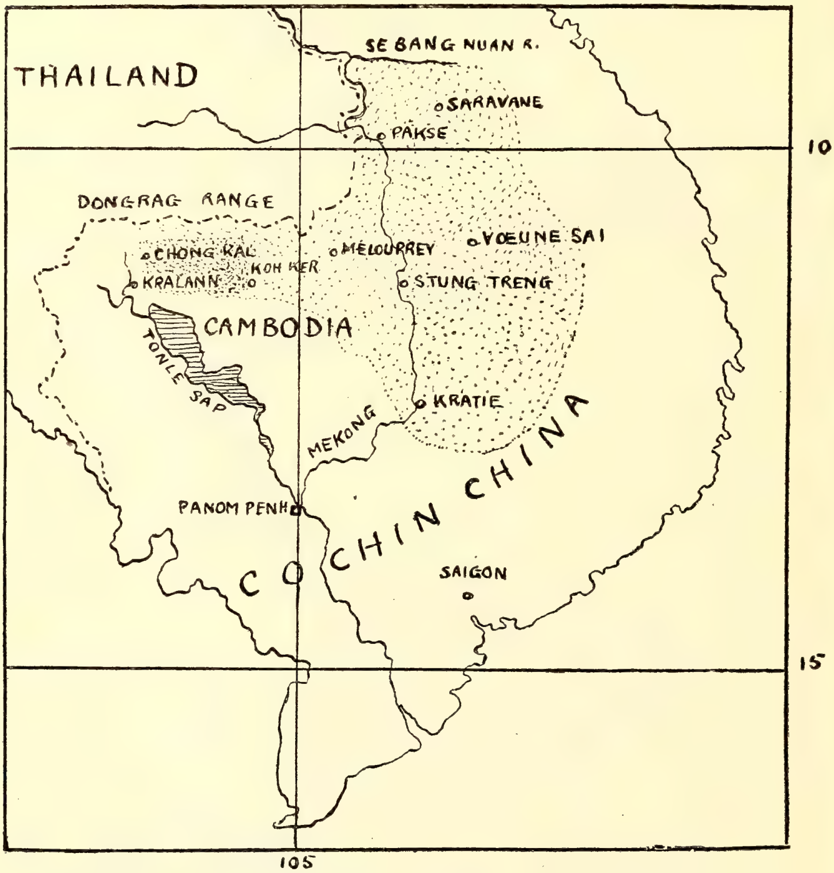
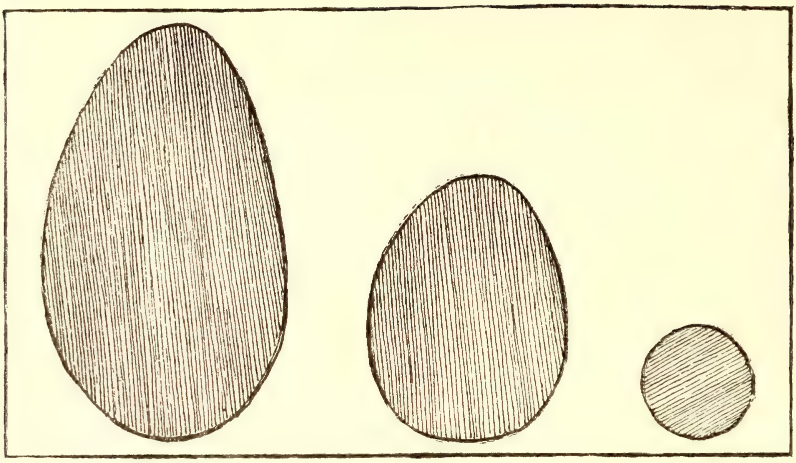


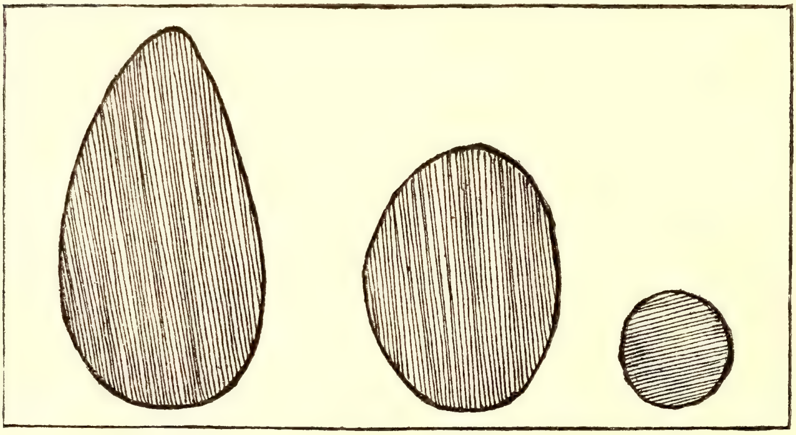
Fig. 2. Map of Cambodia showing distribution of Kouprey (dotted areas)

I was also reliably informed by the Siamese that 30 to 40 years ago there were many Kouprey north of the Dongrag range.



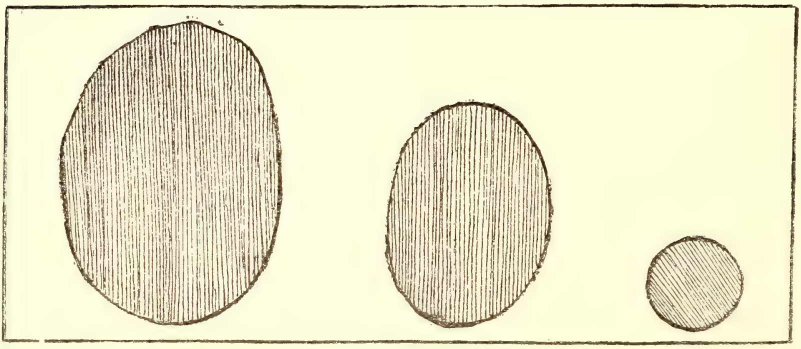
AT BASE AT MIDDLE AT TIP

Cross-section of a bull gaur horn, reduced ½. Front-back.



AT BASE AT MIDDLE AT TIP

Cross-section of a bull kouprey horn, reduced ½. Front-back.



AT BASE AT MIDDLE AT TIP

Cross-section of a bull banteng horn, reduced ½. Front-back.

HORN MEASUREMENTS (in inches)

BULLS:

	Pair No. 1	Pair No. 2	Pair No. 3
Widest outside	38	33·0	35·5
Widest inside	31·5	26·5	29·25
Length on outside curve. Right ...	41·0	32·5	39·5
Length on outside curve. Left ...	38·0	32·5	39·75
Circumference at base. Right ...	15·0	15·0	14·25
Circumference at base. Left ...	15·0	15·0	14·5
Tip to tip	22·0	—	13·5
Distance between bases of horns ...	4·0	3·5	3·5
Distance of tuft from tip	13·0	4·0	Shaven ?

Measurements of six other detached horns :

No.	Circ. at base	Length on outside curve	Dist. of tuft from tip
1. Right	13·5	31·75	6
2. Left	13·5	31·5	7
3. Right	13·75	31·5	4·5
4. Left	12·5	29	4
5. Right	12	30	Shaven ?
6. Left	12	30·5	Shaven ?

COWS:

	Pair No. 1	Pair No. 2	Pair No. 3
Widest outside	19·0	23·75	20·25
Widest inside	13·25	18·75	15·75
Narrowest inside	8·5	15·5	14·75
Tip to tip	14·0	22·0	17·25
Length on outside curve. Right ...	23·75	29·5	20·5
Length on outside curve. Left ...	23·5	28·0	21·25
Circumference at base. Right ...	8·5	7·5	7·5
Circumference at base. Left ...	8·5	7·5	7·5
Distance between bases of horns ...	3·75	3·5	3·75

Corrugation. In a bull there are corrugations at the base of the horns like in those of gaur or banteng, but the corrugations in Kouprey are not as rough as in the other two. In the pair No. 1 which seemed to be the oldest one, there are 6-7 cross ridges which are about 8 inches long altogether from the base of the horns. The horns of younger bulls have shorter and fewer corrugations.

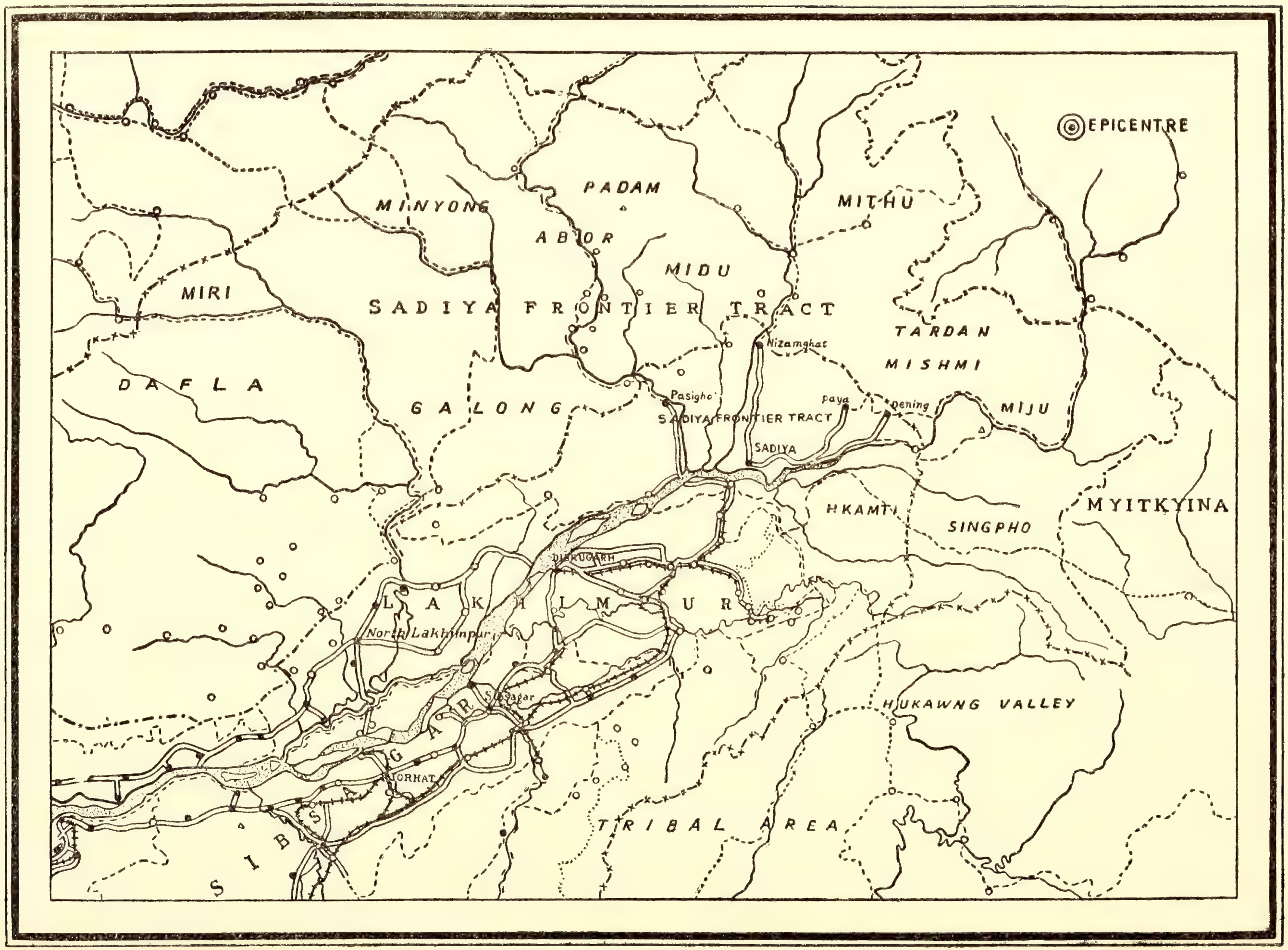
In a cow, there are more corrugations than in the gaur or banteng. In some of them there are a few cross-ridges at the base, and further than that, there are cross bands for about 8-12 inches from the base.

Bushy Tuft of shredded horn near the tips. In every bull, when nearly full grown, say about 2-3 years old, the horns become split at the tips; and as it grows older the tips of the horns continue to grow longer until they are about 13 inches or more. At the same time the bushy tuft grows longer and longer until some strands are about 7-8 inches long. It is very peculiar that these split pieces are thin and fairly regular in width, i.e. about $\frac{1}{8}$ - $\frac{1}{4}$ inch wide. This is quite different from gaur and banteng horns which split up in broad and very short strands near the tips only.

It should be noted also that the bushy tuft shown in the Plate I B is smaller than what it should normally be, because it is much damaged by sparrows in my house tugging at the strands.

Some natives say that this manner of splitting and tuft forming is due to the Kouprey goring and digging into the ground with its horns.

In cows' there is never any bushy tuft at the ends.



Area affected by the Assam Earthquake of 1950

THE ASSAM EARTHQUAKE OF 1950

BY

E. P. GEE, M.A., C.M.Z.S., F.R.G.S.

(*With a map and two plates.*)

This earthquake occurred at about half past seven, Indian Standard Time, in the evening of August 15th 1950, and is generally acknowledged to have been one of the severest in history. The preliminary report of the Advisory Committee, Assam Earthquake Reconnaissance and Survey, states that it was tectonic in origin, and that it appears to have been caused by a sudden fracture of a portion of the earth's crust or by relative movements along old fault lines.

Its epicentre has been located by seismologists at approximately latitude 29° N. and longitude 97° E. This would indicate a spot in the China-Tibet region north of Rima, and some eighty miles north of Walong, the northernmost outpost of the Assam Rifles in that corner of India. The area is one of geological instability, being situated at the eastern end of the comparatively newly formed Great Himalayan Range, an unstable land-mass not in its final stage of equilibrium.

As far as India is concerned, the area most affected is an arc bounded on the west by the Ranganadi river (just to the west of the Subansiri river), and on the east by the Dehing river in the Tirap Frontier Tract. This includes the Abor Hills, the Mishmi Hills and part of the Tirap Frontier Tract, in the newly constituted North East Frontier Agency; and a portion of the plains area of Assam as far south and west as the town of Golaghat in the district of Sibsagar. The duration of the shock was approximately four minutes, and it is now generally assessed as one of the five most severe that the world has experienced in historical times. One source describes it as one of the two biggest in magnitude of recorded history, the other being the Colombia earthquake of 1903. At a symposium organised by the Central Board of Geophysics at the Geological Survey of India, Calcutta, it was calculated to have had an intensity of 8·6—equivalent to the bursting of several million atom bombs. It was greater in intensity than the severe earthquake of Assam in 1897, the one of Quetta in 1934 and the one of Bihar in 1935.

The damage to railways, roads, bridges and buildings was heavy and widespread, and all communications were for some time completely dislocated. Official sources estimated the number of deaths as 1,526; and stated that from 25 to 35 per cent of livestock, including the interesting gayal or *mithan* (formerely classed as a distinct species, *Bos frontalis*) in the Abor and Mishmi Hills, were destroyed or washed away. But as these hills constitute a wild and inaccessible region, no degree of accuracy is possible in computing the amount of damage done there.

Several Abor and Mishmi villages are known to have been buried eternally under huge landslides, leaving no trace of their former existence.

DESCRIPTION OF THE SHOCK

It so happened that at the time of the earthquake Mr. F. Kingdon-Ward and his wife were on a plant-hunting expedition, in camp at Rima in the Lohit Valley just beyond the Assam border. No account of this earthquake would be complete without a few extracts from his able description of the event: '. . the earth began to tremble violently, and a terrible noise assailed our ears . . . Outside we were at once thrown to the ground . . . the near mountainous horizon was blurred, as though the hills were leaping up and down with high frequency. The noise was now terrible, and to the muffled hammering of the earthquake itself beneath us, was added the thunder of rock avalanches pouring down the mountain scuppers . . . The motion was still up and down, as though a steam hammer were pounding the thin floor on which we lay . . . After several tense minutes it began to lessen, and the noise abated somewhat. Rocks were still pouring down the mountain sides with a terrible clatter, but the internal noises had almost ceased . . . High up in the sky towards the north-west . . . came the sound of five or six sharp explosions, very clear; it sounded like anti-aircraft shells exploding.'

This noise resembling the sound of anti-aircraft fire was heard also in the plains. I am indebted to Mr. F. Woolley Smith for some details of the experiences of persons residing in Upper Assam: 'The earth heaved and rolled with a sickly undulating movement. Cars parked on level surfaces with brakes unapplied careered wildly about, fans swung and some lights went out . . . At the end there was a succession of loud booming noises variously described as resembling anti-aircraft fire and express trains.' It appears that the petroleum and kerosene stored in the huge million-gallon storage tanks at Tinsukia 'slopped violently about, shooting yards away through fractured plates and covers'. Incidentally, the oil fields at Digboi, only 18 miles away, were comparatively unaffected by the earthquake.

Even as far away to the south and west as Golaghat, some 100 miles from the nearest portion of the Abor Hills, the shaking was terrifying, and the noise which followed some seconds after the shock was also described as resembling that of a series of bombs or shells bursting in the distance.

The main shock of August 15th was followed by many minor shocks, and these continued for some eight months, gradually becoming fewer and of lesser intensity.

IMMEDIATE EFFECTS IN 1950

Considerable damage was caused by the earthquake to the town of Dibrugarh and other towns, villages and tea estates with their factories. The Assam Railway from Mariani eastwards suffered greatly, rail tracks being torn up and twisted into snake-like patterns. Fissures opened in the ground, most roads were damaged and bridges destroyed.

Occurring as it did in the middle of the monsoon, when the ground was saturated and rivers swollen to their maximum volume, the damage was probably greatest in the wild Abor and Mishmi country. Here many hills, several thousand feet in height, were sheared from top to bottom, their sides crashing down into the valleys below. Rivers both large and small thus became blocked by huge unstable dams of rocks, earth and vegetation, and in some cases actually ceased to flow. Even the huge Subansiri, snow-fed from the higher Himalayas and swelled with monsoon rains, practically dried up for a few days. Then came the bursting of the dams, one by one in some cases, in other cases simultaneously ; and vast flood waves surged down the valleys carrying everything before them, and on reaching the plains spilled far and wide, causing extensive destruction to forests, villages and cultivations.

In some cases the lakes thus formed in the hills by these temporary dams endured for a longer period. For example at the headwaters of the Tidding river, a tributary of the Lohit, a lake nearly four miles long by a quarter of a mile wide was found to have lasted throughout the cold weather into the following spring. This has probably disappeared during the monsoon of 1951.

I was fortunate to be able to make a brief trip to the fringe of the North East Frontier Agency in March 1951. I first of all had the privilege of making two flights over some of the affected areas in a two-seater light aeroplane, thanks to the kindness of Mr. R. C. Reynolds of Sealkotee Tea Estate, who has acquired well-deserved kudos by his help to the State of Assam in air-reconnaissance, relief and rescue work. After this, I visited by road the areas of Saikhowa, Sadiya, Tezu, Timaighat, Rongdoi, Kobo, Murkong Selek and Pasighat.

I found that it was estimated that some 75 per cent of the hills in this 17,000 square mile area were mutilated by landslides. Of these avalanches, less than half appear to have occurred on the day of the earthquake, and more than half afterwards, when heavy rain and subsequent earth tremors assisted the previously fissured hills in disintegrating. There have been reports of still more landslides during the monsoon of 1951.

The floods following the bursting of the dams carried vast quantities of silt and debris, and all the river channels—even that of the Brahmaputra itself—became blocked. This again resulted in further widespread flooding and alarming changing of river courses. For example even in the latter part of October 1950, the Dibang became so silted up that its tributaries Jigiapani, Deopani and Ghurmura could not enter it. These were diverted by the newly formed silt banks of the Dibang on to the town of Sadiya, thus covering it with flood water at an unexpected time of the year.

In the cold weather of 1950–51, after the flood waters of the monsoon had dwindled to the usual low levels, all rivers in the affected area presented a grim sight. Wide tracts of desert-like country with dead trees standing here and there ; thousands of trees torn up from the ground ; and silt, debris and driftwood everywhere. The silting up of these river beds in north-east Assam has considerably altered the topography of that part of India. The Lohit at Sadiya, where it is two miles wide, was believed in March 1951 to have silted up to the extent of four or five feet ; and the Brahmaputra at Murkong Selek to the extent of eight to ten feet and at Dibrugarh some six or seven feet. In addition to this, the adjacent countryside is estimated to have subsided some four or five feet during the actual earthquake, thus effecting a general levelling out of the area—a stern foreboding of floods in subsequent years, as has already been experienced in 1951. The mass of silt in the Brahmaputra is slowly moving downstream on its way to the Bay of Bengal, and after August 1950 river steamers could no longer navigate as far as Dibrugarh, but were forced to terminate their journey at Desangmukh.

EFFECTS IN 1951

Two factors, directly the result of the earthquake, were evident during the monsoon of 1951. Firstly the rapid run-off of water from the landslides in the hills resulted in equally rapid rises and falls in the flood levels of the rivers concerned. And secondly, the silted-up river beds in the plains areas could not contain the flood water, and consequently vast tracts of adjacent land became inundated, some for the first time in recorded history. Major floods occurred in June–July, and again in September.

The river Dibang, in particular, behaved in an extremely treacherous manner, with alarmingly quick rises and falls. Unexpected deposits of silt after a fall in the flood level were apt to cause equally unexpected erosions in the following rise of flood water. For example, a party of officials and tribesmen were taken completely by surprise when the Dibang suddenly changed its course near Nizamghat, the proposed sub-divisional headquarters of the Dibang Valley. They were marooned for some time without any hope of escape, until light planes were brought from other parts of India and crash-landed on a *chapori* for their rescue—a daring and praiseworthy effort.

This flood of June–July moved slowly down the Brahmaputra Valley of Assam, inundating the north and south banks as it went. Travelling by air from Dibrugarh to Gauhati on July 20th, I observed that the flood had receded in Upper Assam; but in Nowgong and Kamrup districts the whole plain from the Himalayan foothills in the north to the Khasi and Jaintia Hills in the south appeared to be a continuous sheet of water, with only trees and the roofs of houses showing. Fortunately the Wild Life Sanctuary of Kaziranga suffered little from floods, presumably because of the lower flood levels of the south bank rivers, and because the Majuli island diverts some of the north bank drainage away from this valuable sanctuary.

In the flood of September 1951, the depth of the water in the compound of the Saikhowa Inspection Bungalow was no less than five and a half feet, and the whole population had to be evacuated. Still worse was the fate of Murkong Selek, where the silted-up Brahmaputra both flooded and eroded the land on which was situated the Assam Saw Mills—the largest of its kind in India, with a production of about half a million tea chests annually. In the three days from September 15th to 17th the Brahmaputra eroded no less than half a mile northwards, sweeping away the entire mills with their bazaar, bungalows, lines, warehouses, workshops and main factory with its irreplaceable plywood machinery. The hapless staff and workers attempted to take refuge on the highest land in the vicinity, where the water was waist-deep, until they were evacuated by air. At that time there was no dry land within fifteen miles of where Murkong Selek had been, and it was reported officially that some 2,000 square miles of Upper Assam were under

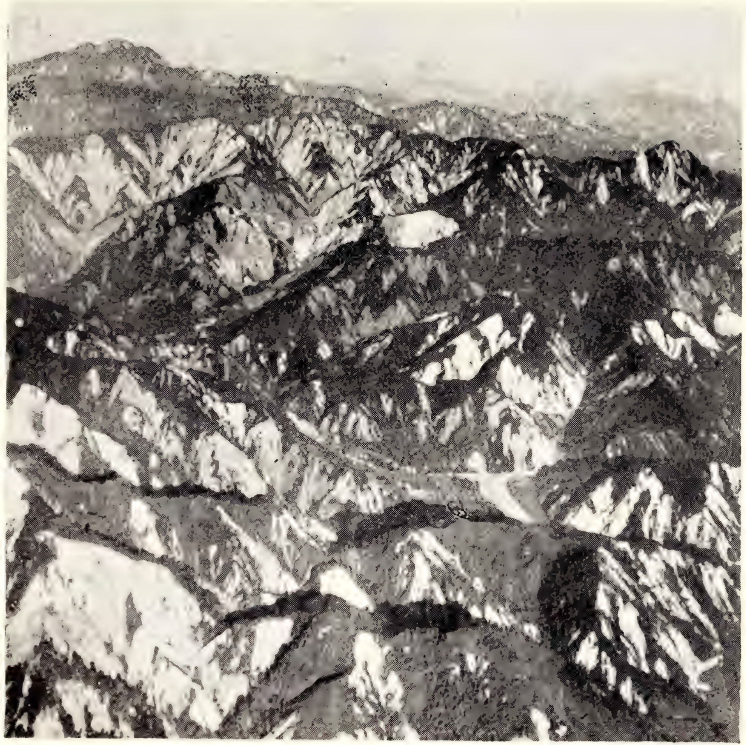


Photo *B. Anderson*

Aerial view of the damage done to a portion of the Abor Hills, between the rivers Subansiri and Simen.

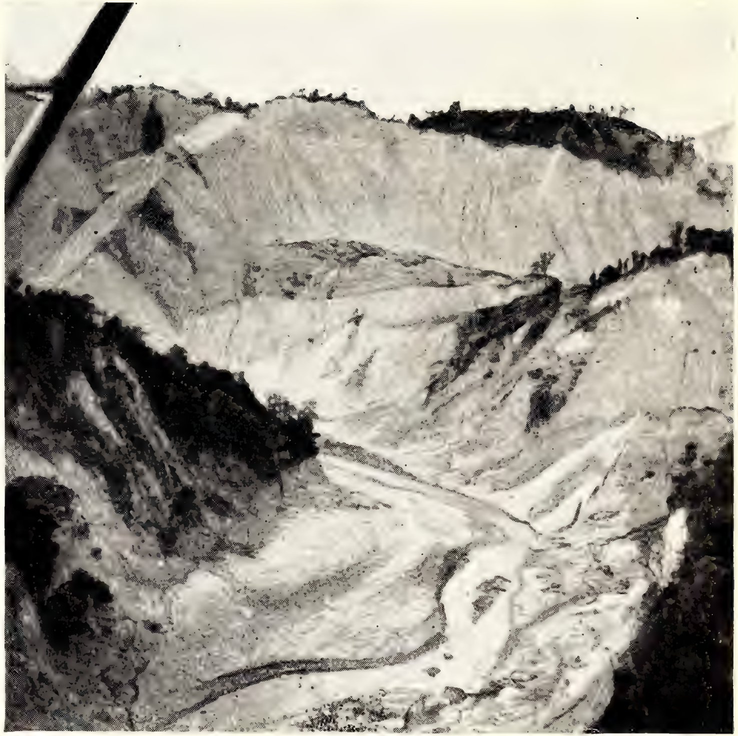
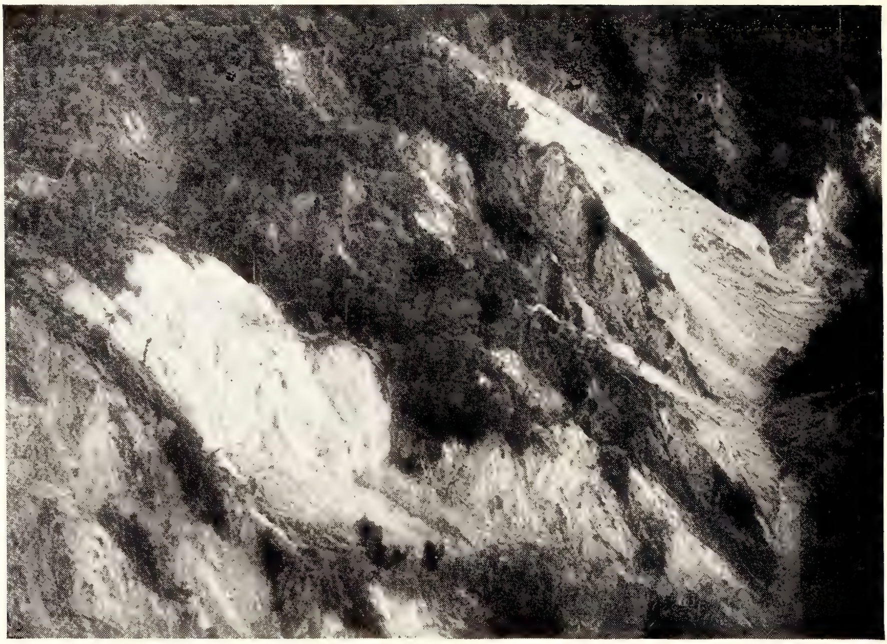
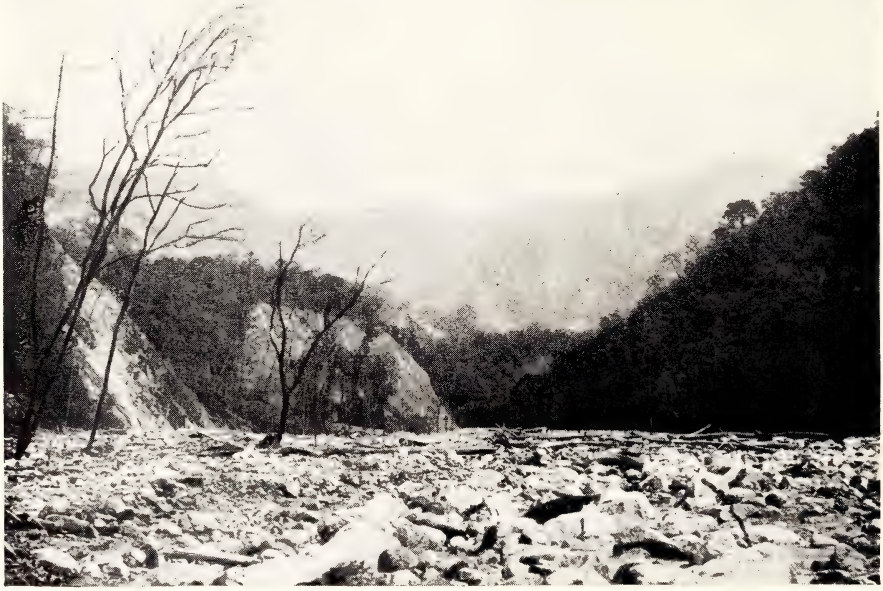


Photo *Author*

The damaged valley of the river Simen north of Dibrugarh. Even in the dry weather (March 1951) the river was running liquid mud.



A portion of the Abor Hills north of Dibrugarh, showing landslides caused by the earthquake.



Photos *Author*

The valley of the Timai, a very small stream in the Mishmi Hills near Parsuram Kunda. Formerly thickly forested, it was a desert of stones and driftwood when photographed in March 1951.

water. Vast timber forests holding valuable plantations of hollock (*Dipterocarpus macrocarpus*), and extensive *chaporis* of thatch, were irretrievably ruined, and much of the wild life they had contained was destroyed.

During the rains of 1951 the Subansiri river twice completely changed its course in the plains of North Lakhimpur. At the beginning of the year it followed its old course, with slight changes since 1950. By August 1951 all these channels were dry, and a new and large channel had formed between Koyam and Baligoan. Then in mid-September it entirely altered its course westwards, engulfing most of the tea estate of Pathalipam. Vast areas of forest and cultivated rice fields were destroyed during the vagaries of this large river.

PROBABLE LONG-TERM EFFECTS

The gradual westward movement of the colossal silt deposits down the Brahmaputra Valley may be completed within a decade or two. But the partial denudation by the earthquake of the hillsides in the catchment areas of the rivers Subansiri, Dihang, Dibang, Lohit, Dehing and all their tributaries, assisted by the indiscriminate felling of forests in all the tribal areas of Assam through the system of *jhuming* (shifting cultivation), will continue for a very long time to cause greater and more accelerated floods in the plains. And until new and deeper channels can be formed by the rivers of these alluvial plains, the widespread flooding experienced in 1951 will be an annual occurrence—and may even worsen. It will probably take some hundreds of years, if not considerably longer, before any satisfactory amount of vegetation can again cover the hillsides mutilated by the earthquake.

It is possible that many riverain districts will have to be evacuated by their inhabitants, and villages and cultivations moved to higher ground nearer the foothills. In this case there would be a seasonal cold-weather return to the riversides of graziers, fishermen and growers of dry weather crops.

DESTRUCTION OF FLORA AND FAUNA

Trees and other vegetation of all types from various altitudes were torn down and swept away by the rivers. Many of these trees were of coniferous species. A major portion of the driftwood could not be salvaged in the plains, and has passed beyond the Indo-Pakistan border on its way to the sea.

Fish in all the rivers from the Subansiri in the west to the Lohit, and possibly the Dehing, in the east are believed to have been totally destroyed by the liquid mud mixed with decaying vegetation which came in the phenomenal flood waves after the bursting of the dams. Countless thousands of dead mahseer (*Barbus tor*), bokar or catli (*Barbus hexagonolepis*) and other species were salvaged by villagers in this erstwhile paradise for naturalists and fishermen, and also lower down in the Brahmaputra Valley. It is feared that nothing is left alive in these rivers of the North-east Frontier Agency. When I saw them in March last, the driest period of the year when the water should be crystal clear, they were all still flowing with liquid mud.

Mr. R. G. Menzies, Political Officer of the Subansiri Area, informs me that though the fishing in the Subansiri river was utterly ruined, he obtained normal good sport in the rivers Ranganadi and Dikrang immediately to the west, although the earthquake was almost as severe in these two valleys. He believes this was due to the fact that these two latter rivers were not blocked by landslides, with the subsequent ill-effects of these, as were the Subansiri and the rivers to the east of it.

It is difficult to estimate the destruction caused among birds. Occurring as it did after nightfall, when birds would be roosting, the earthquake must have paralysed some of them with fear and swept them with the forest to their doom.

The loss among mammals must have been very great. At a conservative estimate, some forty to fifty per cent of the wild animals of the area must have been killed. These would include the vanishing Musk Deer (*Moschus moschiferus*), the rare and interesting Takin (*Budorcas taxicolor*), as well as Serow (*Capricornis sumatraensis*), Goral (*Nemorhaedus*), Gaur (*Bos gaurus*) and other animals. In the plains areas, chiefly as a result of the floods of 1951, Wild Buffalo (*Bubalus bubalis*), Gaur (*Bos gaurus*), Sambar (*Rusa unicolor*), Swamp Deer (*Rucervus duvaucelli*), Hog Deer (*Hyelaphus porcinus*) and others are believed to have suffered greatly.

I found to be quite unauthentic the newspaper report of 1950 about a carcase of a rhinoceros being seen floating past Murkong Selek, with surmises of the existence of *Rhinoceros sumatrensis* or *sondaicus* in the upper reaches of the Lohit or Dehing rivers. No such carcase had been seen.

A letter from Mr. F. Woolley Smith of Tingri in Upper Assam last August stated that the numbers of tiger were on the increase in the district. These must have migrated from the Saikhowa and Dibru Reserved Forests, which became inundated in June and July and are believed to have been mostly destroyed by flood water.

It is feared that the Lalli Game Sanctuary, a *chapori* situated between the Lalli and Dihang rivers and formerly teeming with wild buffalo and various species of deer, has been totally destroyed. Even in July 1951 only about eighteen wild buffaloes in very poor condition could be observed from the air. The floods of September, which completely submerged these *chaporis*, must have completed the destruction of all wild life which could not make their escape from these riverain areas.

It is well known that erosions and floods are a normal and annual occurrence in Assam. But they have in the past been gradual and in most cases within expected limits. But what has happened in 1951, and is likely to take place for many more years to come, was on an unprecedented and alarming scale.

Mr. N. A. B. Warner of Upper Assam, who flew over the affected area on October 28th after the floods had subsided, has described to me the devastation and destruction he saw. Literally thousands of square miles of forest appeared to be dead or dying. Very little vegetation was left alive, and vast swamps still stretched to the foothills. The loss to wild life, already sadly depleted by an excess of sportsmen and poachers during the last few decades, must have been very considerable indeed.

GLOSSARY

Mithan—either a domesticated form of the Gaur (*Bos gaurus*), or a cross between the gaur and domestic cattle; or a mixture of both in varying degrees. Herds of these *mithan* are kept by the hill tribesmen, and are used chiefly as barter or for sacrificial purposes.

Chapori—a chur or island (sometimes a bank) formed by channels of a river in Assam.

Jhuming—a system of shifting cultivation by which forest is felled, burned and planted up; but after a few years is abandoned for another area. In a cycle of twelve years or so all the forest near a village will be so utilized, resulting in a total absence of primeval forest and an excess of secondary forest.

REVIEWS

1. HUNTER AT HEART. By B. N. Gordon Graham. Illustrated by A. I. Cameron and with 15 photographs by the author and others. Pp. 222 ($8\frac{1}{2}'' \times 5\frac{1}{2}''$). London, 1950 (Herbert Jenkins Ltd.) Price 15/- sh.

This book is designed as a guide to young sportsmen wishing to shoot in the reserved and other forests of the Central Provinces of India, the Madras Presidency and Ceylon.

The sixteen chapters deal with choice of a shooting ground and preliminary arrangements for India and Ceylon; shikar days with small game, also deer, buffalo, bison, bear, panther and tiger; notes on all those animals and on beating, sitting up and stalking. Chapter XV is on Taxidermy and Preservation of Trophies, and XVI gives a pen portrait of his Muhammadan orderly, and some memories.

Appendices deal with costs, equipment, words and phrases in Hindustani, Telugu and Sinhalese; and with a list of books suggested for the sportsman's bookshelf. In connexion with this may be mentioned the Bibliography of Books on Big Game Hunting published in Vol. 49 of the *Journal of the Bombay Natural History Society*, August 1950, and No. 134 of that list. The author is a member of the Ceylon Game and Fauna Protection Society, but not of the Bombay Natural History Society.

Generally speaking, the compilation gives well arranged and necessary advice and information, but there are a good many omissions, and also some errors.

Weapons and other matters. Should carnivora be shot at from a motor vehicle at any time? All over India the Rules prohibit shooting from any wheeled vehicle, excepting only case of a man-eater. Does the hammerless rifle safety catch 'invariably' 'click'? Not if properly constructed and oiled. Objection to use of an ejector rifle is mentioned, yet the author advocates the use of this mechnism. Use of a noiseless detachable sling with the rifle is barely mentioned. This should have been emphasized as very necessary as obviating movement when in the forests, lessening fatigue and temptation to hand the weapon to an attendant, and of very great use in machan or tree stance in a beat, and when following up a wounded beast. The essentiality of a light ladder when following wounded carnivora is not mentioned: the ladder, the sling, a piece of rope to secure stance in tree may all be vitally important when following up a wounded tiger or panther. It is not mentioned that sound of a whistle does not carry very far in the forest, and use of a high-note signal horn is much better, and more safe for the beaters. Use of a small greenwood saw for removal of obstructions to swing of rifle is not mentioned, nor the valuable asset afforded by the easily acquired ability to fire rifle from either shoulder. The essential spare foresight should be carried in a 'trap' in the stock or end of pistol grip, and not in the gun case. It is not mentioned that use of fluor oil before pouring boiling water greatly lessens work of cleaning both gun and rifle. Shotgun sportsmen might have been informed that the ring of the standard cartridge extractor is designed to re-gauge dampened cartridges, so should always be carried when duck shooting.

The suggested second rifle might well be the .423 Mauser magazine (8¼ lb.) or the slightly heavier .375 Magnum, either of which is powerful enough to take the place of the heavy D.B. weapon on all occasions in case of need, and better for that and other reasons than the advocated .256 or .350.

Care of cartridges. Suitable advice is given; but it might have been added that cartridges should be carried on the person in pouch or belt, each round separated from the next, with a separate arrangement for two to be instantly available at waist level for re-loading.

Clothing. Rolled-down thick socks are a torture in spear grass. The real solution is to wear canvas ankle-boots, or shoes, and no socks; or rather, trousers of hard material with flexible canvas ankle putties, and so be comfortably protected against all kinds of pests.

Medical. Paludrine has now superseded the mentioned Mepacrine; and there is no mention of quinine. Chlorodyne often dries up, so Camphorodyne is better. Silk for sutures is better than unsafe cotton. M&B. 760 and 125 have a wider use than the listed 693. (Your reviewer brings to notice that the recent M&B 'Sulphatriad', a compound of Sulphanamides, may be valuable in camp). Sulphaguanidine, an essential remedy for bacillary dysentery, is omitted. There should have been mention of 1 lb. of a good chemist's ointment for sores and injuries of jungle people, and sulphur ointment for scabies.

Literature. The 'complete' list at p. 53 makes no mention of the very valuable 'Book of Indian Animals' (S. H. Prater)—also omitted from Appendix 'D'—nor of the 'Folding Chart for Identification of Poisonous Snakes', both of which are published by the Bombay Natural History Society. 'The St. John Ambulance Association First Aid Text Book' with Indian Supplement might be substituted for the recommended Red Cross First Aid Manuals, Nos. 1 & 2.

Most sportsmen are, or should be, interested in trees, shrubs and other plants in the forests. For C.P., 'Descriptive List of Trees and Shrubs of Central Provinces' by Haines (Rs. 3/-) is good, if procurable. Commercial Guide to the Forest Economic Products of Mysore.' (Government Press, Bangalore, Rs. 1/8) is excellent for other parts of South India also. The out-of-print 'Manual of Indian Timbers' by J. S. Gamble is invaluable, but difficult to obtain.

Food Sundries. In these days, food arrangements should wholly discount replenishment from wild life sources. It should have been mentioned that any filtering should precede the essential boiling of all water used for drinking and culinary purposes. The valuable kerosene oil tin is not listed. Candles are of little use without a candle lantern of a type not easily broken which can be packed for transit in a biscuit tin. The 'X' Pattern canvas camp bed with bath and basin should have been advised, also the valuable 'Icmic' cooker.

Small tablets of soap as 'bakhshish' is a good idea; use of any but a new village charpoy is, for several reasons, a dangerous practice. Salt and alum should not only be packed apart from food stuffs but be finely powdered, packed against damp and separately from each other.

Small game. A leather hand-protector for hot barrels when duck shooting is good; but the gun guarded against glint of sun by a tight-fitting slip-on cover of green or khaki drill gets more shots. Use of a .22 rifle for gathering cripples is scarcely a safe practice, for bullets ricochet off water. In these difficult days as to cartridges most sportsmen are satisfied with the ordinary 2½ inch cases. Use of 3 in. cases is unnecessary, and 2½″ or 2¾″ cases give erratic results in 3 inch chambers.

The author has no scruples about eating hares in India. In the wide experience of your reviewer the Common Indian Hare is a very foul feeder in vicinity of habitations, as also the grey partridge and the junglefowl—and, in arid areas, the village cattle too!

The author has confused the junglefowls. *Gallus lafayetti* is the Ceylon species and confined to that Island; *Gallus sonnerati*, known as the Grey Junglefowl (not found in Ceylon) has a far wider range than that mentioned; *Gallus gallus murghi*, also not in Ceylon, is the Common Red Junglefowl of the sāl forest areas, northern India and Assam. The species of Imperial Pigeon referred to is not stated. In Ceylon it would be the Green Imperial Pigeon (also Jerdon's Imperial Pigeon) while in C.P. it would be the latter, with the former also in the more eastern portions. The bird promoted by the author to pigeon status is better known as the Emerald Dove. The Grey Quail is omitted. Large bags of this bird and of the Rain Quail were made by many sportsmen when cartridges were not so expensive or scarce as in these days. Probably the majority of sportsmen prefer smaller sizes than No. 5 for mixed duck and teal shooting.

Tiger. 'The Principle of Moments' described and illustrated at p. 600 of *B.N.H.S. Journal*, Vol. 44, would have enabled the author to weigh his tiger. It is almost unknown for clavicle bones to be missing in tiger or panther.

Buffalo. 'Some individuals tend to have grey stockings', *All* truly wild buffaloes have white stockings.

Chital. Is the record 42 inches, and does it hail from Bhopal? Is it not 39¾ inches, and from the U.P. Siwaliks? In India the practice is to omit the 'h' from the names 'sambhar' and 'nilghai'. Females of deer are usually called 'hind' and not 'doe'; there is no need for the coined word 'carnivorae' to express the plural of mammals that subsist upon flesh or prey upon others. The Wild Dog of India *can* be tamed, and there may be more than six puppies in a litter. As many as nine are known. The illustration, presumably of the Rusty Spotted Cat, at p. 33 is too stocky for this lightly built animal of mostly arboreal habits. The photograph (p. 96) of the first panther killed by the author (1948) could have been more attractively posed. The book is well printed, bound and produced.

There is evidence in places of too much reliance on the writings of others but, notwithstanding the above criticisms, the book will be useful as a guide to the younger sportsman.

R.W.B.

2. HYDROPONICS. THE BENGAL SYSTEM. By J. Sholto Douglas. Pp. 147. Size $7\frac{1}{4}'' \times 4\frac{3}{4}''$. Illustrations. Bombay, 1951 (Oxford University Press). Price Rs. 6/-.

We have no hesitance in saying that Mr. Douglas has done a great service to the popularising of Hydroponics through this book. He makes the subject attractive and practicable through his various suggestions and guidance. The chapters are excellently arranged and the matter treated in a very clear manner. The instructions are brief and clear without being complicated with unnecessary details and explanations. The illustrations are interesting and attractive. Altogether the book is one which all garden lovers in India and specially those who have taken some interest in hydroponics, should possess and treat as a basis for their experiments. The author has succeeded in cutting down expenses quite considerably and brought hydroponics within reach of the common man in India. This is an achievement.

When we turn to the commercial side of hydroponics, however, we do not feel at all convinced by what the book tells us, or by the tables provided. Take Table V: the figures taken for agricultural average per acre of all the grains are extremely low and for non-irrigated crops obtained by inefficient cultivators. It is, therefore, not fair to compare these figures with the hydroponic production obtained by efficient work of those who are practically skilled research workers. Why the agricultural production of potatoes is taken as ½ ton we do not know. The seed-requirement of an acre alone is ½ ton. Even in India a production of 15 tons and over is not unknown. Under Table VIII the prices quoted may be retail prices, but not the average wholesale prices of the produce. Under estimated revenue the author gives Rs. 50,000 as gross value of produce per acre per annum, and Rs. 20,000 as nett profit. This is not understandable. On the previous page under Table VIII we see that maize production per acre is Rs. 1,700 and peas Rs. 1,200, potatoes at Rs. 4,000. If we got one crop of potatoes and two of peas and maize combined, we would at most have a total of Rs. 10,000 as the gross value for a year's production. Tomatoes are the only item mentioned of which the produce from an acre could be Rs. 50,000.

We have no doubt the purpose of the book will be well achieved as it will be able to attract more enthusiasts for work in this field.

J.A.A.

3. THE BIRDS OF THE MALAY PENINSULA, SINGAPORE & PENANG. By A. G. Glenister, F.Z.S., M.B.O.U. With 8 plates in colour, 8 in monochrome (78 species) by Elizabeth M. E. Glenister, 54 text figures and 20 photographs. Pp. xiv + 282 ($8\frac{1}{2}'' \times 5\frac{1}{2}''$). London, 1951 (Oxford University Press). Price 35 sh. net.

Mr. Glenister, although we do not recall any of his published work on Malayan ornithology, has obviously been a keen and observant student. During his long residence in Malaya many years ago, in towns and villages and on tin mines and rubber estates, he seems to have made good use of his opportunities for bird watching. His own notes supplemented and fortified by the writings of seeded Malayan ornithologists like Robinson, Chasen and Gibson-Hill have combined to produce this estimable volume for which bird lovers in Malaya will feel beholden to him.

The first part of the book is of an introductory nature and covers general topics such as geographical divisions of the Malayan sub-region (made up of Malayan, Sumatran, Bornean and Javan Provinces) as defined by Chasen in his 'Handlist of Malayasian Birds' (1935). It is good to find that the toxonomical arrangement, numbering and nomenclature is, in the main, that adopted by Dr. C. A. Gibson-Hill in his recent 'Annotated Checklist of the Birds of Malaya' (1949). To a large extent also the notes on status, distribution and breeding of that competent ornithologist are summarized. They lend added weight to his accounts under each species though it may be a matter of opinion whether the summarising has always been done to best advantage.

In Chapter I, entitled 'The Birds of Everyday Life' is given a list of the 70 bird families which comprise the avifauna of Malaya, together with an indication of the species of each family to be found in the sub-region. An attempt has been made to split up the bird life into 'compartments'—Bird life of the Towns and Gardens, Bird life of the higher Hill Stations, and 'For the Sportsman'. Those with experience of Robinson & Chasen's sumptuous but somewhat cumbersome volumes, 'The Birds of the Malay Peninsula', will be better able to judge the merits or otherwise of this method of treatment though it must be admitted that the demerits are to some extent mitigated when the sections are contained within the covers of a single volume whereby reference does not involve the handling of a separate tome each time.

Aids to field identification are provided firstly by division of the 70 families into three 'Field Groups'—'for field purposes only' as the author explains. To this are added a number of tables—Noticeable colours, bills, legs, tails and other features such as crests, ear tufts (e.g. as in some owls), 'eye-patches' (e.g. as in barbets) etc.

Under Chapter III—The Birds and Bird Families of Malaya—is an enumeration of the species found in Malaya numbered and arranged according to families. First a short general description of the family is given—its constituents, characteristics, flight, calls, food etc. followed by distinguishing points for identification (coloration; size in inches) for each species, and abbreviated information concerning its status thus: *V* = Rare vagrant, V = passage migrant and winter visitor, R = believed to be resident, I = introduced, and so on, indicating occurrence in the various divisions and areas of the sub-region—lowlands, hills, etc.

Part II of the book begins with the Systematic List under which each species is described in greater detail, together with notes on its status and distribution called largely from Gibson-Hill's Checklist. The total number of forms dealt with here is 575; an addendum lists a further 35 species recorded from peninsular Thailand but not yet from Malaya. The abounding wealth of the bird life of this sub-region becomes manifest, and Mr. Glenister's benefaction in providing such a handy and useful guide is certain to receive wide appreciation from bird lovers and would-be students to whom its richness and variety might seem bewildering at the start.

The book ends with 3 appendices—Glossary of Malay Bird Names, A List of the Birds of Sumatra, Borneo and Java, and A List of some Malayan Hill Stations, Peaks and Passes with their approximate heights above sea level.

The spate of tables, footnotes, abbreviations, redundances, instructions for use, appendices, elaborate index and index to footnotes are rather complicated and frightening to one cursorily glancing over the book, and it would seem that so much generous spoon-feeding is not perhaps strictly necessary. A closer acquaintance will show, however, that there is a method in all this, and when the instructions for use are once mastered some of the apparent intricacies will be found not devoid of usefulness.

The illustrations, both colour and monochrome, are attractive and helpful; so also are most of the figures in the text. But the photographs of captive birds, though well selected as to species, can by no means be considered incapable of improvement and many of them might well have been omitted.

The book is a useful addition to literature on Malaysian birds and its handy format should make it a welcome guide to bird lovers in that area.

S.A.

4. ANIMALS STRANGE AND RARE. By Richard Ogle. With numerous drawings in the text by the author. Pp. 192 ($7\frac{3}{4}'' \times 5''$). London, 1951 (G. Bell & Sons Ltd.). Price 12 sh. 6d. net.

This is a pleasantly illustrated book in which we are taken on a magic carpet to the remotest places to look at strange and rare animals, many of which are threatened with extinction. It is an excellent effort covering the whole world and referring to a large number of interesting animals and facts. Accounts of the discovery of the living fossil fish *Latimeria chalumnae,* and the king cheeta in Africa adds to its value for the layman. The latter, presumably *Acinonyx rex*, is, however, now generally regarded as a mutant form of the African cheeta.

The book also serves the useful purpose of helping to arouse that spirit of adventure and discovery which is so rare nowadays. A chapter is devoted to unknown and almost mythical animals like the Himalayan snowman and the Nandi bear. The former is of particular current interest in this country since in spite of the opinion expressed by the British Museum that the footprints seen by Shipton's recent expedition were those of the common langur, mountaineers, shikaries and others have from time to time brought in fragmentary bits of evidence which, when pieced together, do not appear to warrant its dogmatic reduction to so humdrum a creature. The latest verdict, published on p. 572 of this number of the *Journal*, is that it is the Himalayan Brown Bear, as indeed has been generally believed heretofore.

There is no doubt that many strange, rare, and perhaps even yet unknown animals do exist in India or upon its immediate borders.

The relatively recent discovery of the large forest-ox or Kouprey in Siam is evidence that our knowledge is far from complete and that discoveries are still to be made, often in unexpected places. A recent press note mentioned an expedition to New Guinea in quest of a saurian monster which was reported from some remote swamps in a little known and almost impenetrable area there. We hope that books of this kind will arouse interest in the life history of many of our animals of which so little is known, and some of which are now almost on the verge of extinction.

The right kind of public interest can really do far more towards the saving of our wild life than any number of government ordinances and regulations.

A certain amount of literary licence has been introduced into the book, and this becomes more apparent when the author deals with animals nearer to us in India. The picture of the Racket-tailed Drongo on page 124 is unfortunate. On page 119 the Rosy Starling is said to do a large amount of damage to 'rice' in India. This of course is an error for jawar.

Most of the drawings and text, however, are excellent and full of life.

H.A.

5. PROCEEDINGS OF THE XTH INTERNATIONAL ORNITHOLOGICAL CONGRESS, (Uppsala, June 1950). Edited by Prof. Sven Hörstadius, General Secretary. Pp. 662 ($9\frac{1}{2}'' \times 6\frac{3}{4}''$), with 1 coloured plate, numerous photographic illustrations, text figures and graphs. Published by the Board of the Congress. Price 35 Swedish crowns (=£2-8-3 or $6.75).

International Ornithological Congresses have been held in Vienna 1884, Budapest 1891, Paris 1900, London 1905, Berlin 1910, Copenhagen 1926, Amsterdam 1930, Oxford 1934 and Rouen 1938. Then came the cataclysm of the 2nd World War with the inevitable intellectual and cultural vacuum in its wake, so that it was only in 1950 that this friendly International cooperation could be resumed. Actually the Xth Congress was scheduled to take place in the U.S., but owing to the financial upheaval caused by the war, with exchange difficulties and multifarious other restrictions, it became impracticable for impoverished ornithologists from Europe and elsewhere to visit that country. Therefore, to the Swedish Government and the Swedish Ornithological Society (Sveriges Ornitologiska Förening) world ornithologists feel especially beholden for their cordiality in inviting the permanent Executive Committee to convene the Congress in Sweden instead. The warm-hearted hospitality shown by the Government, scientific institutions, the press and the people of Sweden in general, and the well-planned and impeccable arrangements down to the minutest detail, made by the Swedish Ornithological Society through its President, Prof. Hörstadius (also the General Secretary of the Congress) will be testified to by all who were privileged to share in the deliberations of the Congress and of which they will long cherish happy memories.

The 1950 Congress was held at Uppsala from 10-17 June under the presidentship of Dr. Alexander Wetmore of the Smithsonian Institution of Washington. About 350 ornithologists from 27 countries participated. The U.S.S.R. and its satellites remained the only notable European absentees. Unfortunately, also, Asia was totally unrepresented save for a single delegate from India.

This volume of the Proceedings of the Congress opens with an account of the sessions and the field excursions. Owing to the large number of papers on every aspect of bird study that were presented, it has not been possible to print them all in full, even though the tome contains more than 650 pages. They have, however, been skilfully condensed so that none of their original flavour or purport is lost.

An innovation at the present Congress was the special request sent out by the organizing committee to four eminent ornithologists —each of outstanding international repute in his own particular sphere of work—to review the trends and progress of their special disciplines during the 12 years since the meeting at Rouen. No serious bird student who presumes to consider himself, or aspires to be considered, 'in the swim' or up-to-date in his science, can afford to miss the masterly surveys by Dr. Ernst Mayr (Speciation in Birds), Prof. R. Drost (Study of Bird Migration, 1938-50), Prof. N. Tinbergen (Recent Advances in the Study of Bird Behaviour) and Dr. David Lack (Population Ecology in Birds). Dr. Wetmore's Presidential address, 'Recent Additions to our knowledge of Prehistoric Birds 1933-1949', recounts the progress of palaeontology in relation to birds, and gives a useful list of the bird fossils described during this interval.

The volume is so packed with papers of real merit and originality that it would seem invidious to mark out particular titles for mention. But the list of contents will indicate the breadth of the canvas and the wide range of topics covered by the contributions. They may be broken up as follows: Evolution and Systematics (17 papers); Migration and Orientation (19 papers); Behaviour (7 papers); Ecology (23 papers); Regional Faunas (6 papers); Miscellaneous (9 papers, including such diverse titles as 'Progress in Bird Photography and Sound Recording'; 'Conservation on Ornithological Programs'; and 'The Structures in the Avian Pituitary responsible for the transfer of impulses from the Nervous to the Hormonal System'). An account of the Round Table Conference on Bird Ringing at which practical suggestions for international cooperation in this sphere were discussed and adopted, or recommended, is of the greatest usefulness. Most of these contributions are of as high a scientific standard as might be expected from an international pool of this nature. They represent sound original research, and often show amazing ingenuity and perseverance in the planning and execution of experiments in field and laboratory. Apart from the four invited key contributions, each section contains some papers of quite outstanding merit. They indicate the stature which the science of ornithology has attained since 1938, in spite of the war and the abnormal conditions since prevailing. In some aspects, for example Systematics, Animal Behaviour and Ecology, it can justly be claimed that ornithology now leads in the zoological field, and the advances it has made or induced, particularly in these directions, are truly phenomenal.

Those at the Congress who had the pleasure of listening to the fascinating and erudite papers of Dr. H. Johansen (on the bird ringing work of the Copenhagen Zoological Museum) and Dr. W. Vogt ('On the Ecology of the Peruvian Guano Islands') will deplore the absence of these two titles in the permanent record due to non-receipt of the MSS by the editor in time.

To all who were present at Uppsala, and to others merely perusing this volume of Proceedings, the privileged place enjoyed by the English language as a medium of international communication in social, scientific and every other walk of life will be manifest. It is significant that of the 87 papers presented at the Congress no less than 65 were in English. Next came German with 17, and third French with only 5. As this reviewer has observed before, the review of a publication is no place for moralising; but in the context of certain unhappy trends in our country to-day, it may perhaps not be devoid of profit merely to draw attention to this fact, without comment.

The volume is well printed on good paper, and pleasingly produced, and considering the polyglot nature of its contents, is remarkably free from typographical errors. It compels unreserved admiration for its versatile editor.

Ornithologists all the world over will welcome this permanent record of progress and achievements which, as a reference volume, must prove indispensable for every serious student of birds.

S.A.

6. BREEDING BIRDS OF KASHMIR. By R. S. P. Bates and E. H. N. Lowther. Pp. xxxiii + 367 (8½" × 5½"). Illustrated with 151 photographs by the authors and 5 coloured plates by D. V. Cowen. End maps. London, 1952 (Oxford University Press). Price Rs. 25 net.

Kashmir has for so long been a paradise for the ornithologist that a book describing the wonders of its bird life was greatly overdue. Visitors to the country have hitherto found published sources of information regarding the bird life of Kashmir inadequate and sometimes (as in the case of the two papers by Osmaston) difficult to obtain. The reviewer writes with some feeling on this point because he is one of those whose enthusiasm has driven him to take out on each of his several treks in Kashmir all of the six volumes of the 'Fauna'! The publication, in one manageable volume of 367 pages, of the 'Breeding Birds of Kashmir' by that great partnership of Bates and Lowther has therefore been long and eagerly awaited.

Bates's and Lowther's book is the result of more than 20 years of work and 16 separate visits to Kashmir during the summer months. It concerns itself only with those birds of which there is adequate or reliable proof that they breed in Kashmir. As the book was written before the partition of India, the authors regard the State of Kashmir as containing the whole of that area of some 85,000 square miles found within its pre-1947 boundaries.

To keep their book within reasonable proportions and 'to avoid confusion with Plains' birds and those of Kashmir proper' nesting species found only in the four following areas are dealt with:

(*a*) The Vale of Kashmir and the Jhelum Valley from Kohala to Baramullah.

(*b*) The slopes and side valleys around the Vale of Kashmir up to the passes over the Great Snowy Range.

(*c*) The Kishenganga Valley inclusive of Gurais.

(*d*) The Upper Wardwan Valley of Kishtwar.

As long ago as the year 1920, the authors took their first photographs of Kashmir birds with the object in mind of using them to illustrate a book. In the Introduction they write, 'While the five coloured plates contain the majority of the most gaily dressed birds of Kashmir, as well as portraits of a number of species whose photographs we have as yet been unable to obtain, we have aimed at including such photographic illustrations as will help in the identification of each bird and its nest, thereby rendering long descriptions in the text unnecessary. We are only too well aware that our efforts in that respect are by no means complete . . . .' A characteristically modest understatement because of the 167 species of breeding birds described (omitting those mentioned in the Supplement) no less than 99 have been photographed. To anyone aware of the difficulties of bird photography this is an achievement of a very high order. Among the birds photographed there are a number which are notoriously shy and wary. Any photographer who has tried to take pictures of the Blueheaded Rock-thrush must look with admiration and envy on the excellent illustrations, showing both the male and female, in the plates opposite page 84. Most of the water and marsh birds, too, such as the Snipe, the Coot, the Ruddy Crake and others of their kind, are outstandingly unco-operative, yet the authors have managed to lure them into the range of their telephoto lenses.

In India, there are other difficulties apart from the problem of getting the birds to pose for their portraits: the correct type of photographic material is not always obtainable, nor is it easy to store it properly; in the early days, films were slow and in modern times the second world war often made it impossible to get them at all; the developing of films, even in Kashmir, is always a problem because of dust and heat and sometimes of cold. The authors, moreover, clearly did not have such modern aids as flash (and particularly speed-flash) to help them. Therefore to have done as much as they have, is, all things considered, a splendid and remarkable achievement.

I would, however, make one small criticism: not all of the photographs are of the same general standard of excellence: for a book which maintains such a high standard throughout, a little more ruthless editing in this department would not be a disadvantage.

The plates, both in black-and-white and colour are well printed and Mrs. D. V. Cowen's coloured illustrations are pleasing and, on the whole, true to life.

The text is admirable. Accurate observation, careful collation and good use of existing sources of information, much painstaking work in the field, economy and reliability of description make it certain that this book will remain, for many years to come, the authoritative work on the birds of Kashmir. The authors have an intimate knowledge of birds in the field so that their descriptions of behaviour and habits are full of those little touches, born of long study and sensitive observation, which make the word-picture come alive to the reader. Instances are too many to permit of quotation; the reader will have the pleasure of finding them for himself.

The descriptions for field identification are short but to the point and pick out for mention only those characteristics of the bird which are readily noticeable in the field. That excellent habit, begun by Mr. Sálim Ali, of stating the size of the bird in terms of a selected group of more familiar birds is here carried on with beneficial results.

The translation of bird song into terms of human speech has been handled with restraint. To anyone who has not heard a song it will be of no help to syllabize it, but as an aide-memoire to those who have, the system can be very useful. The authors have employed the method with success.

Whether the Kashmiri names used for the birds are equally successful is perhaps open to doubt. The reviewer had the privilege on a visit to Kashmir in 1951 of being able to use the book while it was still in proof form. Attempts to describe birds to his shikaris by means of the Kashmiri names proved singularly unsuccessful. In all other respects, however, it is true to say that, after two months of use in the field, the book proved to be wholly admirable. This, for a book which sets out to be field guide, is surely the greatest praise that could be given to it.

W.T.L.

The following books have been added to the Society's Library since December 1951:—

1. CHECKLIST OF PALAEARCTIC AND INDIAN MAMMALS 1758 to 1946. By J. R. Ellerman and T. C. S. Morrison-Scott. [British Museum (Natural History), 1951]. (A complimentary copy).

2. HYDROPONICS—THE BENGAL SYSTEM. By J. Sholto Douglas. (Oxford University Press, 1951). (A Review copy).

3. CONTRIBUTIONS TO THE BREEDING BIOLOGY OF *Larus argentatus* and *Larus fuscus*. By Knud Paludan (Reprinted from Vidensk. Medd. fra Dansk. naturh. Foren., bd. 114, 1951).

Fifty back numbers of periodicals which include among others, *Journal of Mammalogy* (a Quarterly published by the American Society of Mammalogists) and the *Auk* (a Quarterly Journal of Ornithology published by the American Ornithologists' Union) were presented by Dr. C. Brooke Worth of Bangalore.

MISCELLANEOUS NOTES

1. WILD AND TAME DOGS

The familiar relations existing between wild dogs and one's own pets was published for the first time in 'Wild Animals in Central India' in 1923, viz. 28 years ago.

Winterbotham's letter in Volume 50, No. 1, so far as I am aware, is the first confirmation of my remarks which has been published. As regards Winterbotham's experience I have no doubt that had all his dogs retreated, the wild dogs would have followed them up right to his very feet.

As it was, the wild dogs stayed to fraternise and gambol with the larger dog who was not afraid and had stayed behind.

November 25, 1951. A. A. DUNBAR BRANDER

2. CHITAL [*AXIS AXIS* (ERXL.)]: A STRANGE ATTRACTION

During my years in the Indian jungles I have often been puzzled by the strange attraction the sound of a hand-saw has for the chital and wonder if any of the Society's members can throw some light on the subject.

In Ganjam, Kalahandi, Jeypore Samasthanam (all in Orissa) and in Bastar, I have more than once surprised chital near sawing benches in the forests. In all of these several instances the deer has been attentively facing toward the sound of the sawing, its ears pricked forward listening as it occasionally takes a step toward the source of the sound as if to get closer and discover the agency responsible.

In Belgarh, Ganjam, one of my mates—Ronoo Gond—has actually led me quietly to a bench where a pair of sawyers in his file have continued sawing through a log whilst we have stood near them watching a chital stag staring and listening to them from a distance of some forty feet, only turning to disappear into the undergrowth when we moved towards him. I have brought up this strange habit of the deer with Oriya, Khond, Gond and Muria sawyers, who all confirm the fact that—for some reason unknown to them—chital deer are attracted by 'the crying of the saw' (literal translation). Some of them affirm that chital have been shot due to this trait of curiosity, but I have no concrete proof of any such shooting though it is certainly possible.

The nearest natural jungle noise that a hand-saw cutting through timber resembles is the 'sawing' or calling of the Leopard (*Panthera pardus*) and it may be this sound association that attracts the chital into finding out the source of the sound, though why the deer should stand and gaze at the sawyers as if hypnotised is not understandable especially as it is an extremely alert animal, more so in Orissa where the local villager and his crop-protection gun, blunderbuss and matchlock musket are continually blazing at it, in season and out, doe, fawn or stag so that man is an enemy to be as much avoided as the local carnivora.

P.O. Gudur : Nellore, K. M. KIRKPATRICK
November 11, 1951.

3. MELANISM IN THE BARKING DEER (*MUNTIACUS MUNTJAC*)

In his interesting article 'Jungle Memories' Lt.-Col. E. G. Phythian-Adams (*Jour. B.N.H.S.* Volume 50, page 11) mentions shooting a Barking Deer with a sepia coloured coat. This probably was a melanistic specimen.

Melanism is not rare in this deer in the Darjeeling district; it usually takes the form of very dark brown. There is one such example mounted in the Darjeeling Natural History Museum. Nearly black animals have also been reported.

Kenilworth, C. M. INGLIS, F.Z.S., C.M.B.O.U.
Coonoor, Nilgiris,
November 10, 1951.

4. SAMBAR DEER IN MAURITIUS

(Reproduced from *Country Life*—May 4, 1951 with acknowledgments)

'Sir,

I have recently seen Mr. Kenneth Whitehead's article on deer, and in the hope that it may interest your readers, I send you a few notes on deer hunting in the island of Mauritius.

Deer (*Cervus rusa*) were introduced into the Colony from Batavia by the Dutch in 1639 and now roam in fairly large herds in the wooded districts of the island. Considering its small extent (720 square miles) and the fact that the shooting season lasts only three months, from June to August, it may appear exaggerated to state that 2,500 to 3,000 stags are shot every year. A morning's beat on one of the more extensive chasses, or hunting grounds, yields an average of thirty to forty stags.

A beat usually comprises thirty to forty guns disposed round the area chosen, which usually covers about 400 to 600 acres. The hunters are stationed on small platforms, or miradors, some 200 yards apart from each other. Fifty to a hundred native beaters and as many dogs are employed to dislodge the stags from the bushes and wooded areas, whence they are driven towards the plains and clearings, or chutes, prepared in advance. The stags are shot at while they are crossing these plains and clearings and the sportsmen thus have an excellent opportunity of displaying their marksmanship.

I enclose herewith two photographs, showing two adult stags and a morning's bag on my estate in the district of Black River.

Partridges and quails used to afford excellent sport not so long ago but are now practically extinct thanks to the Mongoose (*Herpestes* *griseus*), which were introduced from India to destroy rats—the vectors of plague and a pest to sugar-cane planters. The young hares (*Lepus nigricollis*) are likewise being preyed upon by the mongoose, with the result that this game animal is gradually disappearing.'

P. O. Box 60, J. RENE MAINGARD DE VILLE-ES-OFFRANS
PORT LOUIS,
MAURITIUS.

[In response to a request by the Honorary Secretary of this Society, for further information Mons. Rene Maingard replied as follows:—

'Referring to my recent article in *Country Life* on the above subject I give you hereunder some brief notes on the occurrence of Sambar Deer in Mauritius.

Its introduction from Java dates back to the Dutch occupation of the Island (1598-1710) since when this wild animal has thriven considerably and now roams freely in the wooded and uncultivated portions of the Island.

Some 2,500 stags are shot annually, the hunting season extending from the first Saturday in June to the first Sunday in September.

This season some 360 stags were shot on my Estate alone (the Estate is named "Yemen" and is situated in the district of Black River), the luckiest bag being on 16th August last when 81 stags were killed by a gathering of 45 guns, including a very fine and rare specimen of a 15/16 year old stag with 34 inch horns.

So far as hares are concerned, these tend to disappear for two main reasons:

1. Their unlawful hunting at night with car spotlights.
2. The destruction of the young by Mongoose (*Herpestes griseus*) also introduced from India in the last century to help destroying rats after a serious epidemic of plague in the Colony.'—EDS.]

5. OLD JUNGLE TALES RETOLD

THE TIGER AS FRUIT EATER

'There is a forest fruit of the shape and size of a wood-apple with a very powerful, pungent, aromatic smell, which tigers and wild dogs eat greedily; this is also the favourite fruit of the *Chenchu* buffalo; but singularly enough the bear, which devours every other kind of forest fruit, will not touch it. The favourite fruit of bears and wild dogs alike is that of the female blackwood tree.'

This is taken from the article titled 'Wild Dogs' written by a forest officer under the name of 'Robin Hood' and published at page 130 of the *Journal* Vol. 10 in 1895. It is an interesting item of jungle lore which will be appreciated by a number of our members.

I have ascertained through the Conservator of Forests, Bellary Circle, that the fruit referred to is that of *Careya arborea* Roxb.,—*Dudippa* in Telegu. The blackwood is *Dalbergia latifolia* Roxb.

BUFFALOES SLAY A TIGRESS

In the same article 'Robin Hood' related the killing by a tigress of a female *Chenchu* buffalo, and the speedy retribution by the maddened herd which slew the murderer of the cow and her calf. He was at the Bairnuti Forest Inspection Shed and while sitting in the verandah one evening was looking at the herd feeding on the fallen fruit of a large fig tree which strewed the ground on the skirt of the forest a stone's throw from the shed.

'There was the "tonk" of a startled sambar, then a combined roaring and bellowing from the forest. Some of the buffaloes rushed back with dismayed snorts, stopped suddenly as if by word of command, circled round and returned to the scene of conflict. In serried ranks, like a squadron of cavalry, with their great heads lowered to the ground, and bellowing out encouragement to their fellows fighting in the forest, they swept onwards to the rescue, while I nimbly ran along in their rear with my rifle. In this order we crashed into the forest. A feeble gurgling noise announced that the buffalo had been vanquished and a hoarse roar of rage proclaimed that "stripes" refused to quit the victim. Then ensued a perfect pandemonium of roaring, bellowing, stamping and crashing in the midst of which I had to drop my rifle and shin up the nearest tree, owing to two blundering buffaloes, who could not force their way through their struggling companions in front fixing their regards upon me, and in insane delusion that I was the cause of all the turmoil, charging me savagely.'

So he lost sight of all that was going on, but after what seemed an interminable time a number of *Chenchus* arrived and with great difficulty appeased the ferocious buffaloes and got them away. The tigress was found trampled deep into the mud and gored all over. Beside it lay the carcase of an immense she-buffalo, and a yard or two away the body of her calf in defence of which she had lost her life.

I saw the Bairnuti Shed when shooting in the Nallamallai Hills in 1902 but had forgotten, or not noticed the remark about the tree fruit so made no enquiry about it.

THREE TIGERS FOUND DEAD. MAY HAVE BEEN RABIES?

'Robin Hood' further relates how no less than three tigers were found dead in the forests by *Chenchus* who averred they had been killed by wild dogs. He had only fired at one tiger, and that fifteen miles away, and did not see the carcases as he had shifted camp. As these three tigers were found within a period of about a week may it be, in view of cases of 'Rabies in the Tiger' which have taken place in Assam, that those tigers died of rabies? Had wild dogs killed them decomposed carcases would not have been found, for wild dogs do not leave their prey uneaten.

A LEOPARD CHILD

At a meeting of the Bombay Natural History Society held on the 7th May 1889 there was read an article by Mr. Jivanji Jamshedji Modi, 'Recorded Instances of Children having been nourished by Wolves and Birds of Prey' which was published in Vol. 4 of the Society's journal at pp. 142-147.

There has been since then no particular other mention of that subject in the *Journal*, but in an article, 'The Power of Scent in Wild Animals' by the late Mr. E. C. Stuart Baker, F.Z.S., F.L.S., M.B.O.U., which appeared in Vol. 27, pp. 112-118 (1920), is related at first hand the quite unique instance of a child being nourished for several years by a female leopard in the jungles of the North Cachar Hills in Assam. That record attracted no attention, possibly because it was tucked away in an article on scenting power of animals, and is now rescued from oblivion for the interest of members.

Mr. Stuart Baker was a well known police officer, an intrepid hunter of big game, an expert ornithologist and a trained observer of natural history occurrences so not in the least likely to have been led away by the story related to him by the people of the village and backed by his personal observations and enquiries made on the spot in his official capacity. He writes:

'Before leaving the subject of feline senses it may be of interest to relate a story of a leopard child which has not yet ever been published though it was pretty well known at the time.

In the North Cachar Hills, where the boy was found, Government taxation used to consist in part of labour, so much being supplied by every village for the upkeep of roads, rest-houses, etc. Sometimes men would petition for exemption from this labour on various grounds, and one day when questioning a man as to why he wanted exemption from such labour he told me that he had a little ''wild'' son to look after and as his wife had recently died he could not leave the village to work or the boy would run back to the jungle.

I accordingly went outside the court to see the ''wild child'' and satisfy myself as to the truth of the story. There sure enough outside was a small boy about seven years old, or less, squatted on the ground like a small animal; directly I came near him he put his head in the air and sniffed about, finishing by bolting on all fours to his father between whose legs he backed like a small wild beast retreating into a burrow. Looking closer at the child I saw that he was nearly or entirely blind from some form of cataract and his little body was covered with the white scars of innumerable healed tiny cuts and scratches. Struck with his appearance I asked the father to tell me all about the boy and he then narrated the following wonderful story which I fully believe to be true, but which my readers must accept or not as they think fit.

It appears that about five years before I saw father and son, the Cachar villagers of a village called Dihungi, had found two leopard cubs close to the village which they killed. The mother leopard had tracked the murderers of her children back to the village and had haunted the outskirts for two days. The third day a woman cutting rice in some cultivation close to the village laid her baby down on a cloth while she went on with her work. Presently, hearing a cry, she turned round and saw a leopard bounding away and carrying the child with it. The whole village at once turned out and hunted for leopard and baby but without success, and finally they were forced by darkness to leave the boy, as they supposed, to be eaten by the leopard.

Some three years after this event a leopardess was killed close to the village by a sportsman who brought in news of his success together with the information that the leopard had cubs which he failed to secure. On hearing this the whole village turned out and eventually captured two cubs and one child, the boy of this story. He was at once identified by his parents, claimed by them, and their claim admitted by the whole village.

Subsequently when visiting Dihungi I interviewed the headman and also the man who actually caught the child, and they both corroborated the father's tale in every detail. It appears that at the time he was caught the child ran on all fours almost as fast as an adult man could run, whilst in dodging in and out of bushes and other obstacles he was much cleverer and quicker. At that time he was only suffering from cataract to a slight extent and could see fairly well, but after he was caught his eyes became rapidly worse. His knees, even when I saw him and he had learnt to move about upright to a great extent had hard callosities on them and his toes were retained upright, almost at right angles to his instep. The palms of his hands and pads of toes and thumbs were also covered with very tough horny skin. When first caught he bit and fought with everyone who came within reach of him and although even then affected in his eyes, any wretched fowl which came within his reach was seized, torn to pieces and eaten with extraordinary rapidity.

When brought before me he had been more or less tamed, walked upright except when startled into extra rapid motion, was friendly with his own villagers, whom he seemed to know by scent, would eat rice, vegetables, etc., and consented to sleep in his father's hut at night. Clothes, being a Cachari child of tender years, he had not been introduced to.

His blindness was not in any way due to his treatment by the leopard—if the story is true—as I found that another child, a couple of years older, and the mother also both had the same cataract. At the same time the defective sense of sight may well have intensified his sense of smell as the loss of one must have caused him to rely more on the other. When caught the child was in perfect condition, thin but well covered, and with a quite exceptional development of muscle.'

BANGALORE, R. W. BURTON
August 13, 1950. *Lt.-Col.*, I.A. (Retd.).

6. THRILLS IN SPORT

The question of the greatest thrills in sport is often discussed by sportsmen. One will say, after a brief reference to a right and left at woodcock, or the fall of a stag that he considers the finest of all is the first pull and rush of a salmon; another, his thoughts further afield, recalls the close approach to a dangerous rogue elephant or a wounded and savage buffalo as the greatest thrills in his experience.

The subject is interesting to anyone who has enjoyed various forms of sport, and has given me food for thought at various times. I consider from my own experience that the thrill afforded by the rush of a salmon or a large mahseer is not so exciting—though very pleasurable—as certain other thrills which have come my way.

It is not easy to analyse the various thrills in sport. Some are sustained, others are momentary. A sulking salmon can become 'boring' in more ways than one.

There is certainly excitement in the first rush of salmon or mahseer, added to the hope that it is a big fish,—and well hooked. Then, too, the anxious consideration of the surroundings: the presence of snags, rocks or rapids; the relief after a successful landing, especially when alone.

I think my first salmon of 12½ lb. gave me the greatest thrill as far as fishing is concerned, because it was on a trout rod and took 1½ hours to tire out, and gaff. A few days later I landed 8 salmon of from 6 lb. to 16 lb. in an afternoon's fishing on a light salmon rod—but it was easy fishing on a lovely pool of the R. Inver and though each fish, on being hooked, gave me a thrill, I remember that it was only a mild form of excitement. In later years salmon of 32 lb. and 28 lb. on the R. Wye and fish of 16 lb. to 22 lb. on a very swift river, the Oleron in the Pyrenees, were more exciting, and I often lost large fish, owing to the hook-hold giving in the strong current. The same thing occurred at times with mahseer in the rivers of Northern India and the River Indravati in Central India, where large fish took out 100 yds. of line and then got round rocks, broke wire traces, and even crushed treble hooks; my biggest was 51 lb. So much for fishing. Let me now refer to other sport.

Pigsticking in the Deccan and United Provinces in India gave many a thrill. The furious gallop, often over bad ground, the striving to get 1st spear, the charges of a heavy boar, standing 36″ at the shoulder are unforgettable. But even more so was the day when we put up and rode a panther. Our horses had to gallop all they knew to get up, and then the panther crouched amongst the tussocks of grass—the latter often 2 to 3 ft. high. Turning hurriedly and searching for the panther, the latter charged and sprang on to the neck of one horse, fell off, and jumped on another horse behind the saddle. It was bucked off and I managed to get 1st spear. Though wounded it still charged, but was soon despatched. Neither of the two riders were hurt, but one horse was scratched on the neck and chest and for 2 days became feverish and off his feed. After that he recovered.

I find it difficult to say whether my 1st panther or 1st tiger or 1st *Ovis ammon*, or any of the ibex (one was 46″), shapoo, bharal, Tibetan gazelle or stags (barasingh) sambar, swamp deer, and chital gave the greatest thrill.

Out of the 18 tigers I bagged the majority were in beats—from machans. There were wounded beasts which I had to follow up on foot. Two of these charged, and twice I have been charged by unwounded tigers whom I surprised on their kills in the early morning.

I have never shot a tiger or panther off an elephant.

There were plenty of thrills in following up wounded tigers on foot, but perhaps my greatest thrill was in shooting 3 tigers in one minute from a machan, in Ahiri. That was in a beat.

I have a vivid recollection of a thrill when a wounded panther got into a thick patch of thorn jungle. I was guarding a narrow path through this, and the beaters were hurling stones into the thicket, when my Indian orderly appeared in the path. He was carrying a loaded shot-gun, and was perhaps 15 paces from me. There was a sudden roar and, as I put up my D.B. .475, the panther sprang on to the man. The latter, luckily for him, had his finger on the trigger of the gun, and fired into the air, and fell backward. So did the Panther—dead. I had fired as he sprang. He must have just reached the orderly, as the latter had 2 or 3 scratches on one shoulder, but suffered no ill effects, as I had disinfectants at hand.

In conclusion therefore I would be inclined to classify sporting thrills as of 3 kinds:

1. The merely pleasant, e.g. wet fly fishing for salmon, trout, sea-trout, grayling, etc.

2. Such sports as demand skill, experience, practice and a quick hand and eye, e.g. dry fly fishing, shooting, fox hunting, and stalking (of the cervidae). One should not forget tunny and tarpon and sword-fish.

3. The most thrilling of all: the pursuit of dangerous game (tiger, elephant, lion, rhino, buffalo, bear, etc.) with rifle or spear (boar).

Still greater thrills abound, no doubt, in steeple-chasing, ski-ing, mountaineering, motor-racing, flying, etc. But should these be included in 'Sport' as here discussed?

A thrill can also accompany a failure. In the Kadir Cup of '09 there were over 100 competitors. Having won 3 heats I found myself in the Final heat, with 2 others. My horse was a 14.2 Arab. The others were English thorough-breds and had the legs of my Arab. So I waited for the jink and got on to the pig's tail, just as he entered a patch of tooth-brush stiff grass. Twice I tried to spear, but the stiff grass covered the pig, and the point of my spear was brushed aside and almost torn from my grasp by the reed-like grass. My Arab was jumping the tussocks and tiring.

As we emerged onto open ground I again got close to the boar, but before I could get quite up I was ridden off by one of the others who was on a very fast horse and who got 1st spear.

V. K. BIRCH, D.S.O.
Col., I.A. (Retd.).

[The above article was prepared by the late Colonel Birch during 1950 for publication. He died in Yorkshire on the 24th January 1951. He served in the Hyderabad Contingent cavalry and was a junior contemporary of the late Brigadier General R. G. Burton and R. W. Burton who sends us this contribution in memory of a fine all-round sportsman who was not, unfortunately, a member of our Society.—EDS.]

7. HOGHUNTING REMINISCENCES

The words of the famous Hoghunters Song, 'The next Grey Boar we see!' were given at page 169 of the Society's *Journal* Vol. XXXIX, No. 1.

It is now known from a note by Inverarity at p. 814 of Vol. XXII No. 4 that the author of the song was Captain Thomas D'Arcy

Morris who used for his signature the last letters of his three names ('Sys'). He also wrote 'Saddle, Spur and Spear' and a number of other songs besides contributing several amusing prose papers to the pages of the *Oriental Sporting Magazine*, 1828 to 1833.

BANGALORE,
August 13, 1950.

R. W. BURTON
Lt.-Col., I.A. (Retd.).

8. UNUSUAL BEHAVIOUR OF THE WHITECAPPED REDSTART (*CHAIMARRORNIS LEUCOCEPHALUS* VIGORS.)

It is more than time that I recorded what I now realise must have been the most unusual behaviour of a party of Whitecapped Redstarts. I had trekked into the Kulu Valley from Simla early in May 1944 and was spinning a gold Devon for trout in the Tithan River about ¾ of a mile below Manglour Bridge. At that point the river is about 3,500 ft. above sea level and some 35 paces across, broken up by protruding rocks interspersed with fast runs and small turbulent pools. On the far bank was a short cliff with its foot in the river and against it a roundish pool, perhaps five feet in diameter. This pool contained a slow circular eddy with an oily surface and was almost completely surrounded by low boulders nowhere more than a foot above water. It was only as my Devon pitched near this pool that I saw its verge was occupied by about 4 to 5 redstarts, all of them facing inwards and intent on the antics of 2 others which were floating in the pool. These two were leaning back on spread tails in the water, their heads held high and drawn back, their opened wings thrust outwards and downwards into the water to maintain balance. In this position they sailed round and round, the pool facing one another across it; when the current drew them towards the pool's centre, they fluttered together and collided breast to breast once or twice after which they drew apart again and repeated the whole performance. The atmosphere of this play was ponderous rather than skittish or vicious, if so heavy a term may be applied to the actions of so small a bird. Neither used his beak or claws and no feathers flew; a quite gentlemanly engagement. I use the masculine gender because I can only assume that this was a jousting match for the ladies' favour. At this stage in the proceedings another most unusual circumstance intervened. I had the misfortune (sic !) to strike a fish which made off down-stream and for the moment demanded all my attention. In the interests of science I know now that I should have broken with that fish forthwith and returned to the redstarts, but a fighting trout put too great a strain on the naturalist's sense of duty, let alone the angler's tackle. Before my fish carried me out of sight of the birds, however, I was able, out of the tail of one eye, to note two further points. That one of the swimmers was apparently worsted and retired to a ring-side seat on the rocks, his place in the arena being immediately taken by a new entrant; and that at one period there were as many as three birds in the pool at the same time. By the time my fish had come to the net and

I had returned to a point opposite the cliff, the birds had all gone. Thinking back on this interesting scene I have considered, and ruled out, other possible reasons for the birds' behaviour. They were not feeding on insects trapped in the eddy; this bird is normally most jealous of its feeding beat on a stream and it seems certain that a party of 6 or 7 could not forgather for such a purpose on comparatively amicable terms. The spectators on the pool's verge ignored each other completely; indeed they seemed torpid, apparently mesmerised by the circling birds in the water. The possibility of a family party at play is very unlikely at that time of year; for one thing the party was too large and for another it appeared to consist solely of birds in full plumage. This redstart is not gregarious and it would therefore seem unlikely that common indignation had banded the party together to punish a transgressor; had this been the case the spectators would surely have shown more interest in the proceedings. I can only conclude that their behaviour was actuated by the mating instinct.

BOMBAY, M. J. HACKNEY
June 1, 1951.

9. BLACKBACKED ROBIN [*SAXICOLOIDES F. FULICATA* (LINN.)] ATTACKING CAR

I have read with interest Mr. Alexander's account of the Large Grey Babbler attacking the metal hub cap of the wheel of a car (*Jour. B.N.H.S.* Vol. 49; 550) in view of my own experience with a Blackbacked Robin. Every time my car is brought into the porch it is attacked by the robin. Sometimes he takes his seat on the rear number-plate and pecks his way upward until he reaches the window pane in the rear. Then he goes back to the number-plate and repeats the performance. At other times he sits on the front mudguard or the bonnet and pecks at it like a woodpecker tapping at a tree. When I drive him away he flies off to a nearby pillar and comes back as soon as my back is turned. His attacks have become so persistent that I am compelled to keep the car in the garage until it is wanted. I may mention that this is one of a pair of robins that have been trying, so far unsuccessfully, to rear a brood in my verandah. It is only the male robin that indulges in this pastime. The female goes quietly about her business.

It is a reflecting surface that is attacked. I do not think, however, that it is the reflection which excites him. It is not as if he sat on the car, saw his reflection and then attacked it. He comes as soon as the car is brought under the porch. He starts from the rear number-plate from where he cannot see his reflection. It seems to me a little game which he has invented for himself.

THE ROOK E. B. WIKRAMANAYAKE
CASTLE LANE
COLOMBO 4.

10. BAYA (*PLOCEUS PHILIPPINUS* LINN.) NESTS ON TELEGRAPH WIRES

On October 7th, whilst motoring from this place to Bangalore, my wife pointed out a number of Baya's nests slung from telegraph wires. On our return trip we stopped to check the actual number of nests, which was twelve including one half-finished nest. Birds were working on some of the nests, evidently putting the finishing touches to them, whilst we were taking the count. All the nests were suspended from a single strand of telegraph wire which crossed over a field of sugar-cane. The area is extremely well-wooded, the particular field over which the colony was suspended being surrounded by trees on all sides and it at first seemed surprising that the Bayas should forego these abundant natural nesting sites and attach their nests to a single horizontal wire.

However, the entire local area abounds with the destructive Bonnet Macaque (*Macaca radiata* Geoffrey) and I feel sure that these are responsible for the many half-finished and finished Baya's nests that we have found over the past month strewn under colony trees, more especially where these colonies are built on Madras Thorn and tamarind trees, and I feel that this particular colony may have attached their nests to the telegraph wire well away from the supporting columns at either end in an effort to avoid destruction by the monkeys. I am more inclined to place the blame for the destruction of birds' nests on the monkeys than the local population, whom I have found to be wholly disinterested and pitifully ignorant of the bird-life surrounding them apart from the capture of storks and the shooting of ducks with crop protection powder guns.

I trust this unusual nesting site may be of some interest to you. The location of the colony is 25 miles from Chittoor on the Chittoor-Chandragiri road in a well-wooded, cultivated valley between high hills through which both the road and railway run alongside each other.

c/o Postmaster, K. M. KIRKPATRICK
P.O. GUDUR: NELLORE
October 14, 1951.

[The suspension of Baya nests from telegraph wires is not unknown. But this departure in habit by a few individuals only from amongst a population of normally tree nesting birds is so local and unusual that one would like to know something more of the factors that prompt it. Mr. Kirkpatrick suggests safety from the ravages of macacques. It would be interesting to discover what degree of extra immunity, if any, nests hung from telegraph wires enjoy over those built in natural situations, i.e. at the ends of pliant and often thorny twigs. We have sometimes found nests on telegraph wires in places where no special danger from monkeys was apparent. Sunbirds also hang their nests from telegraph wires occasionally.—EDS.]

11. COMMON CUCKOO (*CUCULUS CANORUS*) PARASITISING PLUMBEOUS REDSTART (*RHYACORNIS F. FULIGINOSA*)

(*With a plate*)

In 1945, I published a note in this journal (Vol. 45; 419), describing the strange death of a young Cuckoo found in a nest of Plumbeous Redstarts. The nest was actually found in June, 1944. In the following year, in June 1945, I was again in Sonamarg, Kashmir, and found, in almost exactly the same spot as the previous year, another nest of Plumbeous Redstarts containing a young Cuckoo (*Cuculus canorus*); the bird was fully fledged and almost ready to fly. Possessed of the voracious hunger of its kind, it was being constantly fed by both its foster-parents.

The Cuckoo found in 1944 was not too young for a correct identification of its species to be made, but evidence of a more conclusive nature was desirable. The happy chance presented to me in 1945 to photograph the bird with its foster-parent gives me the opportunity now to offer to the editors of the *Journal* proof positive of what, I believe, must be the discovery of a new host of the Common Cuckoo.

I trust it will be conceded, even by those who put their faith in the infallibility of the dead specimen, that a bird in the plate in this instance is as good as one in the hand.

SINGAPORE, W. T. LOKE
October 27, 1951.

[The Plumbeous Redstart does not appear to have been definitely recorded as a fosterer of the Cuckoo in the Western Himalayas before, though from Mr. Stuart Baker's list ('Cuckoo Problems', 1942, p. 187) this is apparently not uncommon with the Khasia Hills race, *Cuculus canorus bakeri*. The only other cuckoo recorded as parasitizing the Plumbeous Redstart is the Indian Small Hawk Cuckoo, *Hierococcyx fugax nisicolor*.—EDS.]

12. NOTES ON THE NEPAL KOKLAS PHEASANT (*PUCRASIA MACROLOPHA NIPALENSIS*) AND THE SPINY BABBLER (*ACANTHOPTILA NIPALENSIS*)

(*With a text map*)

In the fall and winter of 1949-50 Nepalese authorities gave me permission to lead an expedition to the Kali Gandak region of West Nepal. The country north of Tansen, capital of West Nepal, had never been visited before by ornithologists. We spent three months collecting birds for the Chicago Natural History Museum. Our route lay directly north of Gorakhpur, U.P., through Tansen, Baglung, Dana, Tukche and through the Dhaulagiri Range on the left and Annapurna Range on the right to the Tibetan side. We were within a few miles of Muktinath, an important place to Hindu pilgrims. One

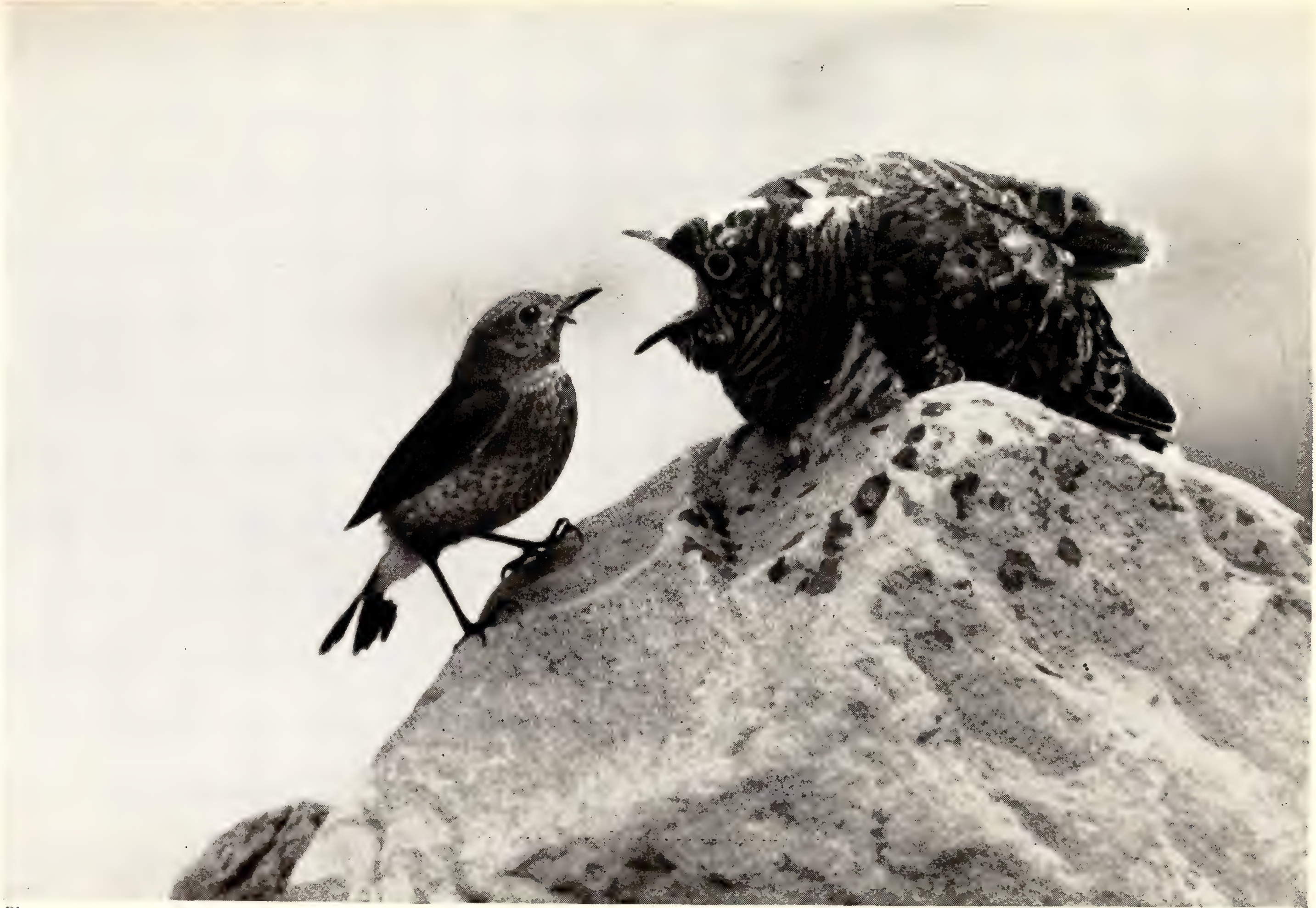
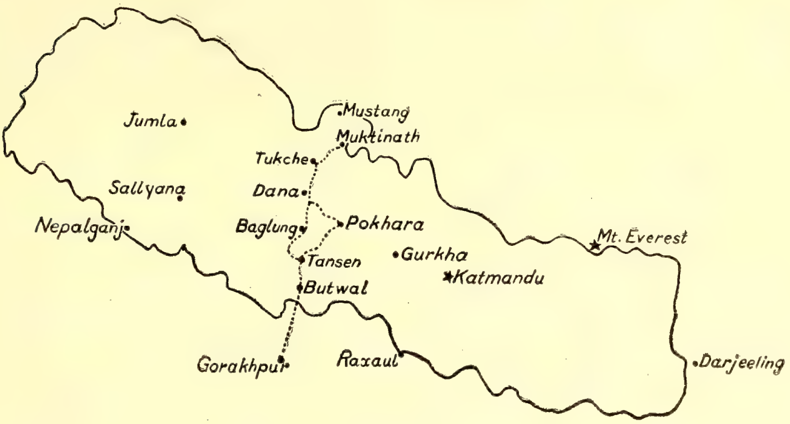


Photo *W. T. Loke*

Cuckoo and Plumbeous Redstart.

of our party secured birds from 18,000 feet. From the higher elevations we secured twelve species of pheasants and partridges.

On our return journey we visited the lake region of Pokhara and beautiful Phewa Tal which yielded us additional rare and little known species including the Spiny Babbler (*Acanthoptila nipalensis*). In comparing our list with that of Dillon Ripley [*Jour. B.N.H.S.*, Vol. 49 (3), December, 1950] I estimate that possibly a third of our birds are not mentioned by him. More than 700 of my Nepal specimens are in Chicago. In this note I only give some data on the Nepal Koklas and the Spiny Babbler regarding which our information is so scanty.



Map of Nepal showing our route........

1. The Nepal Koklas

In February, 1939, I made a trip to Naipalganj Road, Bahraich District, U.P., which is situated on the Nepal border. Permission was given to visit Nepalganj, Nepal. When I reached the town, which was a distance of about three or four miles from where I was staying, I learned that a goodly number of tribesmen had just come down from the hills. Some of them had brought live birds enclosed in wicker baskets. A musk deer (*Moschus moschiferus* L.), in a small box, was displayed along the street. Nearby was a caged Nepal Kalij Pheasant (*Gennaeus leucomelanus*) with no feathers or skin covering his skull. Seeing my interest in the bird, a local man volunteered to take me to a place where there were more caged birds. To my surprise I found two rooms full of about 130 specimens including Monals (*Lophophorus impejanus*), Horned Pheasants (*Tragopan satyra*), Chir Pheasants (*Catreus wallichii*) and Nepal Koklas Pheasants (*Pucrasia macrolopha nipalensis*), but no Nepal Kalij Pheasants. There were also Common Hill Partridges (*Arborophila t. torqueola*) and numerous Snow Pigeons (*Columba l. leuconota*). For a nominal sum I purchased three Koklas, two Horned, two Impeyan and one Chir along with a Hill Partridge. One Koklas and both Horned Pheasants died and were skinned, but the others were brought to Mussoorie and kept for ten months. Meanwhile the birds moulted in July and August and it was possible to obtain exact measurements of them. The Koklas cock which died was much darker than the second one; both were said to have come from the vicinity of Jumla. This second bird more closely resembled those we took on the upper reaches of the Kali Gandak River in northern Nepal during November and December, 1949. Measurements of the two Jumla birds are as follows:

		♂	♀
Wing	...	229 mm	212 mm
Tail	...	203	166
Tarsus	...	62	55
Culmen	...	27	29

Stuart Baker has pointed out[1] that 'very little is known as to . . . how far this Pheasant works East.' One of the purposes of our Nepal expedition of 1949-50 was to obtain skins of this pheasant. We found them in two localities near the Kali Gandak River, some 20 or 30 miles apart. The first place was near Tukche (9,000 ft.) which is located about 15 miles southwest of Muktinath. A small covey consisting of a cock and three hens was located in the blue pine forest (*Pinus excelsa*) at approximately 11,000 feet, above and to the west of the village. They were on the side of a very steep *nala* soon after dawn. A wounded cock flew far down the valley while the hens scattered and were not seen again.

Late in November we established an upper camp (12,000 feet). It was in the shelter of a large rock at the head of a steep valley to the west of Tukche. This spot was only a mile north of the perpendicular wall of rock and snow of Dhaulagiri (26,800 feet). From our tent it was necessary to scale 2,000 feet to reach the wider slopes. Another Koklas hen flew out from a valley covered with grass, bushes and a few large birch trees (*Betula* sp.). A few days after this a shikari brought in a battered cock which he obtained from the heavy fir forest not far below and to the east of Tukche.

Early in December we moved down the Kali Gandak to Dana (5,000 feet), Baglung District, where we had stopped a month before and had collected several Nepal Kalij Pheasants with the aid of hunters and a belled dog. Upon our return we set up a second camp about seven miles northwest of the village. The height was about 9,000 feet; our camp was on the edge of a ringal—oak forest. A Koklas crowed across the valley to the south and another sounded somewhat above us on our side of the hill. We disturbed a Horned Pheasant on the path among bamboos near our tent and later got two. Dr. Carl Taylor and I climbed the grassy terraces above us which bordered the forest. That afternoon Dr. Taylor secured two Koklas cocks from a thick patch of bamboo at about 9,500 feet. The birds were wary and ran at once at the least sign of danger. The measurements of one of the cocks, a young male with rudimentary spurs of about 5 mm in length and rather light in colour, are as follows:

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[1] Baker, E. C. Stuart: Fauna of British India Series, Birds. Vol. 5, p. 313.

Wing 220; tail 191; tarsus 64; culmen 26; crest 80-90 mm. One other cock bird was brought to us at Dana. These specimens are now in the Chicago Museum of Natural History, Chicago, Illinois, U.S.A. The known range of the Nepal Koklas Pheasant is thus extended some 100 miles east of Jumla from where it had been reported by Hodgson more than a hundred years ago.

2. The Spiny Babbler

Our party arrived at Tansen, capital of West Nepal, on November 2, 1949. Tansen is about 65 miles directly north of Gorakhpur, U.P. The city lies on the southern slope and near the crest of a 4,800 foot range. On the northern side, up back of the city, are the Srinagar forests. We were not sure whether our collecting of birds in the vicinity of Tansen would be appreciated so we waited until we left Tansen for Riri Bazaar.

Our road wound along the top of the ridge to the west. Dr. Taylor noticed several birds lurking in a small wayside bush. He secured a specimen which we at once identified as a babbler, but it was not until our return to Mussoorie that it was identified as a Spiny Babbler. Ten weeks later, when again in Tansen, numbers of shy white and brown birds were noted skulking in low bushes of the Srinagar forest but none were obtained. These may also have been this species.

Two other specimens were obtained by me at Pokhara at 3,000 feet. Pokhara is a large town just eight days' trek west of Katmandu, situated on a plain between low ranges of hills. The first Spiny Babbler I secured was one of four or five, flitting through a hedgerow along a lane in the south-western part of the town. The second bird was one of a somewhat larger party found in grass and bushes at the base of a hill directly north-east of the parade ground, only about a mile from our camp. These birds were quite noisy. They would appear for a moment only to dart under cover at once. After a shot all the rest would vanish, not to be found again. In my opinion, this species of babbler is not uncommon, either around Tansen or Pokhara.

'WOODSTOCK', ROBERT L. FLEMING, Ph.D.
MUSSOOREE, U.P.,
April 15, 1951.

13. AN UNRECORDED FEATURE OF SPURFOWL

(*GALLOPERDIX*)

It is curious that none of the standard reference works on Indian ornithology mention a crest in birds of the genus *Galloperdix*. On the 12th instant I was at the Kanheri National Park with Mr. Horace Alexander and we had a good view of a pair of Red Spurfowl (*Galloperdix spadicea*) at a distance of about 30 yards only and both the birds showed a distinct tuft of feathers on the forehead. Mr. Alexander remembered having noticed this in other places in the C.P. and this prompted me to look up the specimens in the Society's collection.

There is no doubt that both sexes of *Galloperdix spadicea* do have slightly elongated feathers on the crown which apparently can be raised in life as a fairly noticeable tuft. The spurfowl is a great skulker and the only view that one ordinarily gets of him is at the wrong end of the gun and this perhaps is why this distinctive feature has so far been overlooked. In the prepared skin the elongated feathers have to be looked for.

Such feathers were not found in specimens of *G. lunulata*, the Painted Spurfowl.

c/o Faiz & Co.,
75, Abdul Rehman Street,
Bombay 3,
July 15, 1951.

HUMAYUN ABDULALI

14. THE CHUKOR PARTRIDGE [*ALECTORIS GRAECA CHUKAR* (GRIFFITH & PIDGEON)] IN NEVADA, U.S.A.

At the present time I am attempting to compare the environments inhabited by the chukor partridge in Nevada, with those found in their native land. To my present knowledge the bird which we have in Nevada is the Indian-hill variety (*Alectoris graeca chukar*) which is distributed from Ladak to Nepal in north-eastern India. The type locality is Srinagar. I have been taking climatological data in Nevada over the past year, and am now interested in comparing the *average monthly maximum and minimum* temperatures and the *monthly precipitation* of a station in Nevada with a *typical* station found in their native habitat. Up to now I have not been able to obtain such climatological data for an Indian station. Records for the year 1950 would be very suitable.

The area where favourable chukor partridge populations occur in Nevada ranges from 4,000 to 7,000 feet in elevation. Daily temperatures fluctuate considerably—having in cases, a difference of 40°F between the daily maximum and minimum. Precipitation is low, averaging around 5 to 7 inches per year. I would be very appreciative of any help which you can offer.

Incidentally, we are having a month-long hunting season on the chukor in Washoe County this year (Sept. 30 to Oct. 31). An opening day check showed that the hunters were averaging nearly 3 birds apiece, which may be considered as very good. Due to a very mild winter, and great amounts of available food the chukor population has increased considerably and the birds are offering some of the best upland game hunting we have had for some time.

Box 9460,
University Station,
Reno, Nevada,
October 24, 1951.

GLEN C. CHRISTENSEN

[The Deputy Director General of Observatories (Climatology and Geophysics), Poona, has kindly supplied the following data for two stations lying within the native distributional range of the Chukor (*Alectoris graeca chukar*) which enable interesting comparison.

Muktesar, Naini Tal District, 29°28′N × 79°39′E. Altitude 7,500′ – 7,700′.

	Maximum	Minimum
Mean daily temperature (Fahrenheit) ...	73·2 (June) – 49·8 (Jan.)	35·5 (Jan.) – 58·0 (June, July)
	Mean annual 63·0	Mean annual 48·3
Average rainfall in inches ...	12·37 (July)	0·42 (November)
	Annual average 53·55″	

Mussooree, Dehra Dun District, 30°27′N × 78°5′E. Altitude 6,000′—7,500′.

	Maximum	Minimum
Mean daily temperature (Fahrenheit) ...	76·5 (May)—49·5 (Jan.)	36·3 (Jan.) – 60·7 (June)
	Mean annual 63·5	Mean annual 50·1
Average rainfall in inches ...	31·35 (August)	0·49 (November)
	Annual average 97·69″	

At these two stations the difference between the daily maximum and minimum temperatures is at no season normally above 20 degrees, while the precipitation is considerably higher than in Nevada.

No climatological data are available for Ladakh, but in some respects the conditions there may approximate more closely to those mentioned in Mr. Christensen's note.—Eds.]

15. THE WHIMBREL (*NUMENIUS PHAEOPUS*) IN ASSAM

Mr. G. E. D. Walker of Margherita P.O., Upper Assam, has sent us the bill of a whimbrel shot at the Ledo airfield which is worth recording since this bird has actually been so seldom noted in Assam. Ledo is at the north-eastern extremity of the Assam Railway.

In the *Journal* Vol. 13; 570, Stuart Baker records a young male, one of a pair shot by Mr. V. Woods of the Assam-Bengal Railway at Haflong on 1st September 1899. The species is not mentioned by Stevens in 'The Birds of Upper Assam' nor by Stuart Baker in 'The Birds of North Cachar' though both refer to the Curlew. It is also omitted from Stuart Baker's 'Birds of the Khasia Hills'. In his serial on 'The Game Birds of India' in the *Journal*, Vol. 35; 712, Stuart Baker says, 'I shot one bird of this race (*N. p. variegatus*) on a small lake in N. Cachar in 1899, which had been in the company of two others, and I saw a small flock in Lakhimpur in 1900 . . . . It is a common winter visitor to the Indo-Chinese countries and Burma and probably also to Assam and Eastern Bengal.'

114, Apollo Street, Fort,
Bombay.

EDITORS

16. BLACKNECKED GREBE (*PODICEPS NIGRICOLLIS* BREHM) IN BHAVNAGAR

During my bird watching visits to the Ruvapari Tanks and sewage waters only a mile away from Bhavnagar, I came across the Blacknecked Grebe on 7th November 1951. The bird looked so different from the common little grebes or dabchicks that I took a few cine shots of it before collecting the specimen. It was a male in winter plumage.

I beieve this to be the first instance of its being recorded in Saurashtra.

Bhavnagar, K. S. DHARMAKUMARSINHJI
December 4, 1951.

[Identification of the specimen has been confirmed.—Eds.]

17. SOME BIRD NOTES FROM JASDAN, SAURASHTRA

On the 12th November 1951 I had been to a lake some 15 miles from Jasdan where I was surprised to see a Great Crested Grebe, (*Podiceps crisatus cristatus*) in winter plumage. M. K. S. Dharmakumarsinhji who was with me confirmed the identification. This bird is a very rare straggler to these parts having been previously recorded in Bhavnagar and Kharaghoda.

Another rare winter straggler seen by us was the Starling (*Sturnus vulgaris*) four birds among grazing cattle on the lake side. They were all collected and have been sent for identification as to the subspecies.

Jasdan, Y. S. SHIVRAJKUMAR
December 3, 1951.

[Apparently *S. v. poltaratskyi* Finsch. In the B.N.H.S. collection we have two specimens of this race collected by the Gujarat Ornithological Survey at Saiat (Kaira District), December 1945.—Eds.]

18. MORE STRAY BIRD NOTES FROM MALABAR

1. Cuckoo chick fostered on King Crows

On the 30th of May, 1951, I came across a pair of King Crows (*Dicrurus macrocercus*) which were feeding a fully-fledged cuckoo chick. The chick flew from tree to tree when I attempted to catch it, while the king crows, though agitated, kept at a distance. I left the chick finally on a tree more than 100 yards away from its original perch. The next evening the chick was found once again on the very same twig where it had been first found, and the king crows were observed feeding it often. When the 'gunman', who had agreed to shoot the chick for me, and I were standing under the tree, one of the king crows flew past the chick, uttering short, sharp notes, whereupon the chick left its perch and followed the foster-parent to a distant tree. Now and then one or both drongos bullied the crows and a Crested Serpent-eagle which flew over us.

After shooting of the chick it was found that the king crows left the area—where they had been the most conspicuous birds—entirely.

To the best of my knowledge, we have four parasitic cuckoos with us in spring: the Koel (numerous); the Common Hawk Cuckoo (common); the Plaintive Cuckoo (never more than two or three); and the Indian Cuckoo (uncommon—never more than half a dozen).

2. The Breeding of the Little Ring Plover (*Charadrius dubius*)

In the latest authoritative account of the birds of the west coast, Mr. Sálim Ali's 'Ornithology of Travancore and Cochin' (*J.B.N.H.S.* 39; 581), it is said of Jerdon's Little Ring Plover: 'No specific instance of its breeding in Travancore and Cochin has hitherto been recorded'. As this seems to be true of Malabar also, it may be worth while placing on record that this Ring Plover breeds regularly in numbers in the rivers of the Palghat taluk from December to June. In Kavasseri, on the bed of the river Gayatri, at least 29 times they have nested between April 1943 and June 1951.

March, April and May seem to be the months when the majority have nests. Four times nests were found in December: Dec. 27, 1948, c/2; Dec. 28, 1948, c/2; Dec. 19, 1949, c/2; Dec. 20, 1950, c/1.

The usual number of eggs in a full clutch is three; I have never found one of four.

The birds which nest late in May always stand a serious risk of having their eggs or chicks washed away by monsoon floods. This year for instance, on June 3, there were three pairs of Ring Plover in the river, each with a family of chicks. One pair had 3 chicks, another had 1, and the third had an egg and a newly hatched chick. On June 4 this last egg also hatched. On the 11th the river was in spate and the chicks undoubtedly perished. Two pairs out of the three disappeared at this time, the third pair remaining with us till about 20th June, and resorting to the grassy banks, laterite flats and the marshy paddy fields for their food.

Throughout the month of May this year I had wandered about on the river bed noting that there were three pairs of Ring Plovers, and confident that only one of these had a nest (May, 28 c/2). On June 3 I was on the river bed, in heavy rain which a strong wind was driving almost through me. A Ring Plover was found brooding over, what I thought must be eggs. Though its mate was uttering warning calls this bird got up and ran away only after I had gone very near it. When it got up, three tiny chicks ran away from the shelter of its wings and fluffed-out breast feathers. The moment I walked off the parent got the chicks safely tucked up under it once more.

Some 150 yards away yet another Ring Plover was sheltering a single chick in the same way. Another 150 yards, and I came across the pair whose nest I had found on May 28. Here it looked as though one bird was sitting on an egg and the other protecting a chick from the rain. On June 5 also the birds were found protecting their brood in this fashion.

3. The Breeding Season of the Blackheaded Oriole (*Oriolus xanthornus*)

The Blackheaded Oriole is said to breed from February to July, but on the September 24, 1950, I discovered a pair feeding two chicks in a nest on a mango tree. On the 25th the chicks were still being fed. On the 27th the nest was found torn to pieces, by some predatory bird most probably.

4. Paradise Flycatcher (*Tchitrea paradisi*)

The last date on which a Paradise Flycatcher was seen in the plains this year (1951) was April 24 (Olavakkode). Throughout April the birds were found to be rare and had to be carefully looked for. On May 15 I was at Padagiri (Nelliampathy hills) for a few hours, and was surprised to find a Paradise Flycatcher of uncertain sex at the edge of a forest by the roadside. I watched the bird for a long time through fieldglasses.

In view of the fact that Mr. C. R. Stonor repeats (*J.B.N.H.S.* 46; 118-125) Kinloch's statement that white males were found predominant on the hills, it may be interesting to know that in the plains of the Palghat Gap white males as well as chestnut males with streamers are rare at all times, though birds whose sex cannot be distinguished in the field are very common. Mr. Sálim Ali does not tell us (*J.B.N.H.S.* 38; 303) whether he found white males more common than the others in the Nelliampathies, but states that at Nemmara, 'Red plumaged males and females were common, but white males exceedingly rare.' My experience suggests that white males, when with us, prefer jungles and forests where they have more cover, whereas the birds of 'uncertain' sex frequent the more open jungles, gardens etc. Is it not probable that this may have something to do with the white males' greater need for protection? If within their breeding range, the white males also are found to frequent inhabited areas and open countryside, it may be due to the boldness that breeding birds invariably display. Night Herons, for instance, fearlessly go about collecting nesting material even at noon during the breeding season, whereas, at other times, they hide very carefully throughout the day in thick foliage.

5. The Common Grey Hornbill (*Tockus birostris*)

In 'The Ornithology of Travancore and Cochin' (*J.B.N.H.S.* 39; 21-23) only three hornbills are listed as occurring in those states. In Kavasseri, which is close to Nemmara, one of the collecting camps of the Survey, the resident breeding hornbill is the Common Grey Hornbill. The Pied Hornbill, the only other hornbill of our place, is just an occasional visitor during the monsoon months. It would be most surprising if the Common Grey Hornbill were found to be totally absent at least in that part of Cochin State which lies in the Palghat Gap.

6. The Southern Greybacked Shrike (*Lanius schach caniceps* Blyth) as a Mimic

It is well known that the Rufousbacked and Greybacked shrikes are expert mimics. But, unfortunately, they seem to be rarely disposed to give performances. Of the many Greybacked shrikes I have known, only one indulged in mimicry, and that too only on three evenings. But this bird displayed real taste in the call notes it chose to mimic. Within half an hour it gave excellent renderings of the notes of some fourteen different birds. Almost every bird which has an interesting call or song was included, e.g. the Common Hawk Cuckoo, the Redwattled Lapwing, the Whitebrowed Fantail Flycatcher, the Indian Nightjar, the Plaintive Cuckoo and the Whitebreasted Kingfisher. Every time the Hawk Cuckoo's '*pipeeah*' notes were uttered they were either preceded or succeeded by the '*teeti-teeti-teeti*' preface which the Hawk Cuckoo itself very often does not utter. In the case of the Redwattled Lapwing, the '*Did you do it*' call was invariably preceded by the '*trick . . trick . . trick*'. When taking off the Whitebreasted Kingfisher, the shrike faithfully reproduced the first notes which sound like a stammerer's efforts to commence a sentence.

As no other avian mimic has such an astonishing repertoire, it is a pity that the shrikes do not give more frequent performances.

7. A GREYBACKED SHRIKE USING LARDERING TACTICS TO TACKLE NEEM FRUITS.

In a thin teak jungle bordering on cultivated land and scrub, a pair of Greybacked Shrikes (*Lanius schach caniceps* Blyth, most probably) has been found every summer for the past seven years. This year, in the first week of June, they were found feeding two full-grown chicks which must have left the nest many days ago. On June 15, when I could no longer distinguish between adult and young, one of these birds was observed eating a ripe neem fruit in an interesting fashion.

The shrike picked up a fruit from the ground, hopped on to a thin, low bush and very dexterously, with a sudden downward sweep of the bill, impaled the fruit on a dry, upstanding twig. Then it peeled and ate the fruit bit by bit, slowly turning the fruit about. Now and then the fruit fell off and the bird had to jump down, retrieve it and refix it. Once it wasted a couple of minutes vainly trying to fix a fruit on a twig which was green and still had leaves on it. Every time the bird tried jabbing the fruit on the twig, the fruit fell off and had to be fetched from the ground. After a time, the bird hopped back to the first twig and succeeded in its very first attempt to get the fruit fixed satisfactorily.

GOVERNMENT VICTORIA COLLEGE,
PALGHAT, MALABAR.

K. K. NEELAKANTAN

19. FURTHER NOTES ON THE BIRDS OF THE NEPAL VALLEY

Sitta himalayensis: Whitetailed Nuthatch.

A nest found at 8,000 ft. on Phulchok ridge on February 25. It was about 5 ft. from the ground in a rhododendron tree. Both birds were carrying nesting material into the hole which was built up with white mud. On April 8 both parents were feeding young which appeared well feathered when I flashed a torch into the nest hole.

Acanthoptila nipalensis: Spiny Babbler.

Since reading Dr. Ripley's article in the December 1950 number of the *Journal* I think my previous record of this bird must have been a mistake[1]. It differs from the illustration in the *Journal* as follows. White of throat less pure white, more dirty or off-white. The bill is less slender. The iris is brown not white. Otherwise it looks much the same but the bird I saw was always solitary and could not have behaved less like a sociable *Garrulax*. I have not seen one this winter, but hope to get a specimen sometime to clear up the doubt.

Actinodura nipalensis: Hoary Bar-wing.

Common on the ridge leading up to Sheopuri 7,000-8,000 ft., also on Phulchok ridge at the same height. Has many low churring notes, also whistle 'tui whee-er' very like that of the Streaked Laughing Thrush with which I think I have confused it in the past.

Siva cyanouroptera: Bluewinged Siva.

Fairly common at Godavari, usually in flocks with babblers, yuhinas etc. Until my husband shot one I had failed to identify it in the field, and had been much puzzled over this small bird which appeared to have a grey head contrasting with rufous back and black and white wings. The blue of the head and wings cannot be easily seen. The crest also is not visible and the bird appears very long and thin with very flat head, a curious distinctive shape. I have only seen it in jungle quite low, 5,000-6,000 ft. but only in winter so presume it moves to higher levels for breeding.

Leiothrix lutea: Redbilled Leiothrix.

I heard the male singing for the first time on March 4, and during April a pair obviously had a nest in thick scrub at 5,500 ft. Both birds would scold us whenever we passed, though owing to the thickness of the jungle I failed to find the nest.

Certhia discolor: Sikkim Tree-creeper.

We shot 2 of these birds at Godavari during December and they proved to be of the above species. Not seen there after the beginning of February.

Cyornis hyperythra: Rufousbreasted Flycatcher.

A single male shot at 8,000 ft. on Sheopuri on April 22. It was so much on the ground that I had mistaken it in the distance for a chat of some kind.

Niltava grandis: Large Niltava.

A female shot in jungle above Godavari at 6,500 ft. on January 28. No others seen.

Niltava sundara: Rufousbellied Niltava.

A male spent a couple of months in our garden from January 15 till March 8. Very quiet and tame and always found in the same patch of bushes. In March it began to be more active and would chase other birds which entered its strip of territory. I never heard it utter a sound.

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[1] But see note No. 12 (2), p. 661 by Dr. R. L. Fleming.—Eds.

Niltava macgrigoriae : Small Niltava.

Fairly common from March onwards at Godavari. The males have a curious little grating song, uttered *sotto voce*, a sort of sub-song, but they seem to have no other. On April 1 I saw 2 males challenging one another. They were only about 2 feet apart with feathers fluffed and both uttering this curious song, a mere thread of sound. They keep their bills open while singing. So engrossed were they that I could get very close to them, though they are usually shy. I have not seen them anywhere else except this west valley of Godavari, not above 6,000 ft. A male shot March 11.

Rhipidura albicollis : Whitethroated Fantail Flycatcher.

Seen several times up the west valley at Godavari 5,500 ft. during January.

Seicercus castaneiceps ; Chestnut-headed Flycatcher Warbler.

Seen fairly often at Godavari during January, February and early March in mixed flocks of babblers, willow-warblers etc.; occasionally in our garden. Not seen above 5,000 ft. One shot February 19.

Abroscopus schisticeps : Blackfaced Flycatcher Warbler.

Not common. A pair seen at 7,500 ft. on Sheopuri on New Year's day in a flock of tits. Seen occasionally at Godavari during February.

Ploceus philippinus : Baya Weaver Bird.

Nests found this year by K. Kilburne in pine trees in his garden. Is it not very unusual for these birds to build in pines?[1] Pine needles are also partly used in the construction of the nests.

Hypacanthis spinoides : Himalayan Greenfinch.

This year these have been very common all winter in the Valley and in the Embassy garden. They are still here in flocks (June 4th). In 1948-49 I hardly saw one.

Aethopyga nipalensis : Nepal Sunbird.

The common sunbird of the hills round the Valley, where it is abundant all winter. In summer not seen below 7,000 ft. In my previous notes I made a stupid mistake and noted Mrs. Gould's Sunbird as being common. The latter bird is in fact extremely rare here.

Dicaem ignipectum : Firebreasted Flowerpecker.

Very common this spring from February 25 onwards. The numbers seem to vary greatly in different years.

Pitta nipalensis : Bluenaped Pitta.

A female shot at Godavari, 5,600 ft. on January 28. This is the only one seen.

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[1] In the Konkan it sometimes builds in Casuarina trees (*Casuarina equesetifolia*), but this is decidedly uncommon.—EDS.

Picus chlorolophus : Small Yellownaped Woodpecker.

A male shot by a little boy with a catapult and presented to me on February 5 was the first one I had seen in the Valley. Have since seen it on Nagarjung uttering the most peculiar call, a trill of 5 or more ascending notes. If I had not seen it calling I should have thought the call to be made by some variety of cuckoo. Also utters a loud 'quaaa' at intervals. Has, moreover, a wide range of more woodpecker-like trills, and it also drums.

Rhopodytes tristis ; Himalayan Greenbilled Malkoha.

March 20 and 29 in our garden, very tame, and uttering at intervals of 4 to 6 seconds a most peculiar croak.

Caprimulgus indicus : Jungle Nightjar.

Common on Nagarjung. First heard calling mid March, but nightjars are seen on this mountain all winter, and I think this species is resident.

Falco peregrinus peregrinator : Shahin Falcon.

Seen for the first time this summer. In our garden May 21 ; on the hills at 7,000 ft. on May 27. It is smaller and very much darker than the race which visits the Valley in winter. The bird seen flying on the hills was almost black with a very conspicuous cheek stripe.

Falco severus : Hobby.

Arrived in our garden this year on May 30, a day later than in 1948.

Elanus coeruleus : Blackwinged Kite.

Seen once only on June 1st in our garden.

Sphenocercus sphenurus : Wedgetailed Green Pigeon.

A single bird shot on Nagarjung at 6,000 ft. on April 21. I have often caught glimpses of green pigeons before without being sure of their identity. They are often heard whistling in the hills during April and May.

Gennaeus leucomelanus : Nepal Kalij Pheasant.

Common on Nagarjung, less so on the other hills. At the end of March they are evidently pairing, as the cocks collect in open places and challenge other cocks. They make the most extraordinary noises and appear to dance round in circles.

Unfortunately I have never been able to approach close enough to see the whole display. There are usually 3 or 4 cocks dancing and fighting and a half dozen or more hens. On June 4th on Nagarjung I saw a cock and two hens and about a dozen tiny chicks. Although very small, the chicks used their wings when following the parents downhill and appeared able to fly fairly well. I was surprised to see the cock with the hens and apparently helping with the chicks. The dark stripe down the chick's neck was very conspicuous.

KATMANDU, NEPAL DESIRÉE PROUD
June 4, 1951.

20. OCEANIC AND OTHER BIRDS SEEN ON TWO RECENT TRIPS BETWEEN COLOMBO AND ADEN IN 1951

I was so interested to read Mr. W. W. A. Phillip's paper on the Wilson's Storm Petrels, Shearwaters and other sea birds in the Gulf of Aden and Indian Ocean [*J.B.N.H.S.* Vol. 49 (3)], that I was moved to keeping a careful diary of the birds seen between Colombo and Aden on two recent voyages.

It was interesting to compare the complete absence of birds seen in February with the very large migration that was observed moving in a southerly direction on August 4, 1951. This migration was presumably being undertaken by birds leaving their breeding grounds somewhere in the Persian Gulf.

The following are extracts from my diaries:—

R.M.S. 'Orcades'

Homeward Voyage—February 28th to March 5th 1951.

February 28. Sailed from Colombo at midnight. No birds seen across the Indian Ocean at all.

March 4. 09.00 hrs. ship was off Cape Gardafui—quite a few Red Sea Blackheaded Gulls seen and 4 Bluefaced Boobys. There were also a few solitary terns (unidentified).

March 5. Entered Red Sea—Lesser Blackbacked Gulls; Herring Gulls (quite a few in juvenile plumage); 2 Red Sea Blackheaded Gulls and 1 Redbilled Tropic Bird seen.

R.M.S. 'Orion'

Outward Voyage. August 3 to August 8, 1951.

August 3. Sea calm with a swell, weather hazy and cloudy.

09.30 hrs. 2 different species of moths seen on board together with a locust.

09.35-09.50 hrs. A large flock of Wilson's Storm Petrel seen sitting upon the sea with others flying around very like Common Swifts skimming the water.

10.10 hrs. The ship disturbed another large flock of Wilson's Storm Petrels.

10.30 hrs. Another large flock of Wilson's Storm-Petrels seen.

10.55 hrs. Red Sea Blackheaded Gull was following the ship.

11.30 hrs. Ship arrived off Aden. Aden Gulls; juvenile Blackbacked Gulls were seen and a Peregrine was seen to make half-hearted stoop at the Aden Gulls.

16.00 hrs. Ship sailed from Aden. A Brown Booby was seen fishing just outside the harbour; it dropped into the water from quite a considerable height and was totally submerged.

A large number of Caspian Terns (? Black head; dark grey mantle; flight feathers appeared lighter than rest of wing; underparts white; tail fairly long; bill orange.)

17.50 hrs. A dark chocolate coloured shearwater (Wedgetailed probably) with a flock of Wilson's Storm Petrels.

18.10 hrs. A solitary black storm petrel was seen, but not identified.

August 4. Ship's position at noon Lat. 12°53′N, Long. 51°21′E. Sea calm with long swell. In the afternoon the wind freshened and the sea became choppy becoming rough.

07.45 hrs. A solitary Redbilled Tropic Bird seen.

08.40 hrs. A solitary Palefooted Shearwater seen. (This was a light brown bird with long pointed wings which it flapped frequently; it moved very fast.)

09.30 hrs. A Wedgetailed Shearwater was seen. (This appeared smaller and darker chocolate than the last species; the flight feathers were noted as being nearly black in colour.)

Wedgetailed Shearwaters were seen throughout the morning together with a couple of Palefooted Shearwaters.

10.40 hrs. 4 Bluefaced Boobys were seen.

15.30 hrs. Large flocks of Dusky Shearwaters were seen. It was quite apparent that the ship was cutting across a very large southerly migration of birds as the number seen was impossible to estimate. The following species were seen in this order of predominance:—Wedgetailed Shearwaters, Palefooted Shearwaters, Dusky Shearwaters, Sooty Terns, Brownwinged Terns and the odd Aden Gulls. This migration was still continuing until approximately 18.30 hrs. when the volume of birds noticeably slackened; as the ship was averaging about 19 knots per hour we had proceeded approximately 57 nautical miles since the start of the migration. The depth of front can therefore be estimated at 57 miles across a very close mass of birds. It was, indeed, a most interesting spectacle.

18.00 hrs. The ship passed Socotra.

August 5. Ship's position at noon Lat. 11°27′N, Long. 59°10′E. Sea rough; strong S.W. monsoon wind blowing; weather fine and clear.

07.00 hrs. A solitary Wedgetailed Shearwater seen.

11.30 hrs. A solitary Pomatorhine Skua (the white markings on the upper sides of the wings were very prominently noticeable); a Wedgetailed Shearwater was keeping company with this skua. During the morning 21 Wedgetailed Shearwaters were seen all of which were solitary birds.

14.10 hrs. Wilson's Storm Petrel (a solitary small petrel which was black with a white rump and underparts was seen).

16.40 hrs. A solitary tropic bird was seen, it was too far for definite identification. Another solitary Wilson's Storm Petrel was also seen.

18.00 hrs. Wilson's Storm Petrel—solitary bird. From 14.00 hrs. to 18.00 hrs. 9 Wedgetailed Shearwaters, all of them solitary, were seen.

August 5. Ship's position at noon Lat. 9°29′N, Long. 66°35′E. Sea calmer with moderate long swell; wind had lessened considerably; weather fine and clear.

08.00 hrs. Wedgetailed Shearwater, solitary bird seen.

08.20 hrs. Palefooted Shearwater seen (this bird was much lighter in colour).

10.55 hrs. 2 Palefooted Shearwaters flew in front of the bows and settled on the water.

11.40 hrs. Another Palefooted Shearwater seen.

11.45 hrs. 3 Wedgetailed Shearwaters.

11.55 hrs. A Redbilled Tropic Bird was disturbed by the ship and rose up from under the bows, giving me an excellent view. It had a short tail and no streamers.

During the afternoon a further 9 Wedgetailed Shearwaters were seen at odd intervals.

August 7. Ship's position at noon Lat. 7°56′N, Long. 74°13′E. Sea calm with light swell; wind slight; weather fine and cloudy.

09.50 hrs. A single Palefooted Shearwater seen. The Palefooted Shearwaters do not appear so graceful as the Wedgetailed as their flight is heavier with considerable flapping of their wings. The Wedgetailed swerve and glide with great speed along the troughs of the waves and appear to keep closer to the surface of the water.

14.00 hrs. A Redbilled Tropic Bird seen. (This bird was complete with streamers in its tail.) No other birds were seen all day.

August 8. Ship arrived Colombo at 06.00 hrs.

SUMMARY

The dates of the voyages undertaken by Mr. W. W. A. Phillips were: homeward—11th to 19th July 1949 and, outward—13th to 20th January 1950; whereas those of mine were: homeward—28th February to 5th March 1951 and, outward—3rd to 8th August 1951.

In January 1950 Mr. Phillips saw the following species of birds: Lesser Blackbacked Gull; Herring Gull; Aden Sooty Gull; Large Crested Tern; Aden Gull; Blackheaded Gull; Dusky Shearwaters; Redbilled Tropic Bird; phalaropes; Wedgetailed Shearwater; Pomatorhine Skua; Brown Booby; Whitetailed Tropic Bird and Brownheaded Gull. The majority of these birds were seen in the Gulf of Aden and only tropic birds were met within the Indian Ocean. In March 1951 I saw no birds whilst crossing the Indian Ocean; this fact, I consider, was due to most species having left the open ocean for their breeding grounds.

Mr. Phillips saw quite a few shearwaters in the Gulf of Aden, which is comparatively close to land to the north and south; these birds may have been moving slowly to the north in the vicinity of the Persian Gulf to breed. I saw no phalaropes on my trip.

It would be interesting to ascertain the local breeding times of these species mentioned as this may explain the reason why so few birds were seen by me. Is it possible that the tropic birds breed at a later date than the other species? Alexander gives the nearest breeding grounds of the Redbilled Tropic Bird as the islands in the Persian Gulf and, the Whitetailed Tropic Bird as on the Mascarine, Seychelles and Andaman Islands; which may account for the reason why the Whitetailed Tropic Bird was seen by Mr. Phillips in the eastern section of the Indian Ocean.

Mr. Phillips expresses his surprise at seeing so many shearwaters off Colombo in July 1949; I also saw quite a few in August 1951. In view of the large southerly movement seen by me on 4th August it may be possible that the birds seen by Mr. Phillips were early breeders or non-breeding birds.

Alexander states that the Wedgetailed Shearwaters breed at the Seychelles and Mauritus, which makes it difficult to explain why I saw so many moving in a southerly direction across the Gulf of Aden. I feel certain that these birds must have been returning to the open ocean from their breeding grounds, otherwise I am at a loss to explain the reasons for such a large movement. Again I am at a loss to explain the presence of Palefooted Shearwaters as Alexander gives their breeding locality as the western coast of Australia, the North island of New Zealand and Lord Howe Island.

On 18th July 1949 Mr. Phillips witnessed a large movement of Sooty Terns flying in a south-westerly direction, these terns were also present in the very large movement seen by me on 4th August 1951, but were definitely in the minority.

The species of birds met on both Mr. Phillips's and my trip appear to be the same with, of course, a difference in concentration. The large movement seen by me on 4th August was a truly remarkable sight.

Mr. Phillips stated that on 19th July 1949 he saw many Wilson's Storm Petrels that appeared to be in moult with ragged plumage; although I saw many of these birds in August 1951 I did not notice any with ragged plumages.

KUTTAPITIYA,
PELMADULLA, CEYLON
October 17, 1951.

C. E. NORRIS

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21. BIRDS ATTACKING THEIR REFLECTIONS

I was greatly interested in the three communications on this subject in the *Journal* [Vol. 50 (1) 171-174]. May I make a further comment? I am glad to note that my old friend Mr. Hamid Ali has had a parallel experience to my own with the Large Grey Babbler in Delhi. Mr. Cumberlege has, I think, misunderstood me. It is quite well known that birds will attack their own reflections in a mirror or in a window. Such instances have been published again and again. Experiments have been carried out with Blackbirds and other species, and convincing evidence has been produced to show that it is the sight of the reflection that causes the attack. I was not questioning this at all; I was only questioning whether it was the right explanation in the case of the babbler attacking a hub-cap.

On this essential point the long note from Mr. H. G. Acharya, recording a very similar experience with Jungle Babblers (*Turdoides terricolor*) is of the greatest value and interest. It appears that Mr. Acharya had not read my note, and did not know how closely parallel his observations were to mine and those of my friends in Delhi. But there are important differences. First, at Ahmedabad it appears that the habit is confined to Jungle Babblers; Large Grey Babblers do not do it, though they are present. In Delhi, though both species are present their roles are reversed. The Large Grey attacks, the Jungle refrains from attacking. This is surely rather odd.

Mr. Acharya is convinced that it is the sight of the reflection in the cap that causes the bird to attack. He points out that the curve of the hub-cap does not distort the picture of the bird. That is true; but it greatly reduces its size. Is it likely that a bird will rush to attack one of its species which appears to be a long way off? If it were by nature pugnacious towards its own kind, perhaps; but neither of the babblers in question is a bird (like the robins or some others) that drive off their own kind. On the contrary, they are constantly feeding in more or less peace with the other 'sisters' of their family party. Yet, suddenly they break away from this peaceful social behaviour to attack one of their own kind which, if seen at all, is seen far away. Moreover, as friends of mine and I myself have again and again noticed, they rush to the attack from a position in which they cannot possibly see any reflection in the hub-cap.

I confess I am still puzzled. I hope other readers of the *Journal* will contribute their evidence. I think very careful and scrupulous observation will be required if we are to discover the true solution.

144, OAKTREE LANE,
SELLY OAKS,
BIRMINGHAM, 29,
December 10, 1951.

H. G. ALEXANDER

22. SCENTING POWER OF BIRDS

Since November 1949 there have been published in *The Field* a number of letters from correspondents on 'Scenting Power of Birds'.

Some have said that carrion birds only have this sense of smell, others that it is evidenced only by seed and insect-eating birds such as pheasants, pigeons, grouse and others. The latest letter—15th July 1950, p. 110—is from one correspondent with 7 years' experience of pursuit of ptarmigan. He says these birds have a very keen sense of smell, that it is no use attempting to stalk them down wind, that he and his companions have been on more than one occasion winded a quarter of a mile away. The latest are two letters in the issue of 4 November 1950 in which a Major R. H. Welge and Mr. Dugald Macintyre both make very positive statements as to scenting power of birds.

Welge says domestic hens detected newly sown peas four inches below the ground; and Macintyre repeats the statements as to ravens having a sense of smell so acute as to be able to detect the taint of human smell on gins—presumably traps of iron—when almost down on the carrion placed in the trap as bait. He also says that ravens have a sense of smell so acute that they can move on to hidden carrion as a pointer dog does on game. One of these two also discredits Darwin's experiment as to scenting power of the vulture.

Are all these observers just deceiving themselves, or are their statements to be credited?

Most people think that birds have very little sense of smell. In course of his very interesting and authoritative series, 'The Study of

Indian Birds' in ten chapters, published in the Society's *Journal,* Vols. 33 to 35, Whistler remarked (Vol. 33; 784) 'Birds as a class are believed to have little or no sense of smell'.

Here we are in 1950 A.D. and this matter of Scenting Power of Birds undecided! Vultures, eagles, falcons, hawks, kites, crows; geese, ducks, junglefowls, domestic fowl, pheasants, partridges, parrots are all to be found in the several zoological gardens of this country. It should not be too difficult to have blinkers-caps made to fit the species of birds to be 'investigated' and so find out what scenting power is possessed by each of them for the food they are accustomed to eat.

A suggestion is that, given the necessary interest in the matter, it should not be too difficult for naturalists, aided by the several superintendents of the zoological gardens (who would doubtless afford all help and facilities) to carry out the experiments and make the essential careful notes in each case.

As to birds scenting human beings photographers taking photographs from 'hides' do not seem to bother much about that!

What is needed is an expert investigation of the kind carried out by Capt. Allen Payne regarding 'The Sense of Smell in Snakes' which was published in Vol. 45 (pp. 507-515) of the Society's *Journal.*

BANGALORE, R. W. BURTON
August 10, 1950. *Lt.-Col.,* I.A. (Retd.).

23. CHANGES IN SCIENTIFIC NAMES OF INDIAN BIRDS

The occasion of the publication in the *Journal* of my 'Birds from Nepal 1947-1949' [49 (3) 1950; 355-417] prompts me to write and to attempt to explain to the members of the Society why I have apparently departed so radically from the system of nomenclature familiar to many students of Indian birds who work with the 'Fauna' series.

In a previous number of the *Journal* [47, (4) 1948; 790] it was announced that the Honorary Editor, Mr. Sálim Ali and the undersigned proposed to start a five-volume handbook on Indian birds. It has been agreed between us that the first priority in this cause should be given to the completion of a Handlist of the Indian birds, and this I have been currently at work on for some time. The urgency of this work is manifest to professional workers. The standard work on Indian birds, the 'Fauna' series, published between 1922 and 1930, was an attempt to modernize the treatment of Indian birds previously revised in 1889. And yet much of the work of Mr. E. C. Stuart Baker which made these volumes admirable lay along other lines from those of bringing the nomenclature up to date. In effect, a good deal of this technical side of the work was already outdated on its publication.

Ornithology is by no means a regional subject, but unfortunately some world areas have suffered from regionalism. There are the International Codes and Rules of Nomenclature, and of course workers of many other nationalities to be reckoned with in the systematic study of birds. It is today a quite outmoded process to attempt to work in a vacuum without regard to these outside and stimulating influences.

Since the publication of the last edition of the 'Fauna' series, there has been a great spate of systematic ornithological research, partially inspired by the recent advances in genetics and in ethology. New theories of the technics of evolution have come to light, and in addition at present there is an outstandingly active generation of professional ornithologists. These workers today are publishing papers on families and lesser groups of birds often rather removed from the Indian subregion, but which bear by implication on Indian systematic problems. A study of African bulbuls, for example, may reveal relationships in that group which require the suppression of a generic name. The combined genus may have two identical specific or subspecific names requiring under the International Rules, the suppression of the latter of the two, with the consequent introduction of some little-known previously suppressed old name, or the erection of a new name. These tedious, extraneous and troublesome details (from a field naturalist's point of view) have to be ironed out and brought up to date if nomenclature as such is to continue to exist.

So much for changes in names. The question of the order in which birds should be listed is perhaps even more arbitrary. The class Aves is a great mushroomed, sprawling aggregation of families, some obviously related, others of questionable relationship, which is certainly not subject to linear arrangement. No proper family tree can be diagnosed. The mere listing of birds means running out each branch to the terminal twigs, and then retracing one's steps back to the main trunk to seek the next nearest branch in the order, and so on and on. Personal opinion obviously enters as regards which branch to follow first, second and so on.

The order itself has changed a great deal. That followed by the immortal 'Catalogue of the Birds in the British Museum' may still be preferred by some. Others may choose that of Hartert in his 'Die Vögel der paläarktischen Fauna'. Currently among students of world birds it seems that most do or will follow the order and arrangement of families proposed by Wetmore and followed largely by Mr. J. L. Peters in his 'Check-List of Birds of the World' (Harvard University Press, seven volumes now published). This arrangement commences with the most primitive families and leads up to the most advanced, though as to the exact sequence to follow there will probably continue to be arguments for many generations to come. This is the order being followed by authors working on checklists of neighbouring areas such as Burma (Smythies), the Indo-Chinese subregion (Deignan), Indo-China (Delacour), Malaya (Gibson-Hill) and Ceylon (Phillips). It seems far wiser, therefore, to make a definite and thoroughgoing break with the traditional arrangement of Indian bird families and swing into line with the main stream of world opinion on such matters. Only harm will be done by continuing to remain in the old mould, (and this I say consciously, as a distant kinsman on my mother's side of A. O. Hume). It is for the above reasons that I have been bending every effort to bring the Indian Handlist up to date, and to speed its appearance.

'Kilravock'
Litchfield, Connecticut, U.S.A. S. DILLON RIPLEY
July 28, 1951.

24. THE ORTHOGRAPHY OF ENGLISH NAMES OF BIRDS

In any Handlist, Checklist or any other list of birds, the inconsistencies shown in the orthography of the popular names is always a matter for wonder. Thus, in one Checklist which I saw recently, the following appeared on opposite pages, 'Water-Hen' and 'Watercock'. Similarly, person may write 'Sea Eagle' in one place and 'Eagle-Owl' or even 'Eagle-owl' in another.

In an attempt to bring some order out of chaos, the following 'Rules' are submitted for the consideration of the Editors and other readers of this journal. In framing them Simplicity, Clarity and Consistency have been regarded as of fundamental importance.

A: NOUNS

Where the name of a bird consists of two NOUNS, the words should be joined by a hyphen, thus:—

Serpent-eagle, Magpie-robin, Hawk-cuckoo, Eagle-owl, Hen-harrier, Snow-pigeon, Scops-owl, Fish-owl and so on.

For the sake of simplicity it is suggested that the second noun be written entirely in lower case.

The exceptions to this Rule would be:—

(i) Where constant usage has made a different form familiar, e.g. Peafowl, Nuthatch, Nutcracker, Stonechat, Flycatcher, Woodpecker, Sandpiper.

The Rule of simplicity would appear to demand the elimination of the hyphen wherever possible and, to my mind, this, in most cases, could be applied. Clarity, however, forbids the writing together of two words, one of which ends and the other begins with a vowel, for example, 'Eagleowl'. A name which is a borderline case is 'Laughingthrush': 'laughing' being a present participle can be used as either a verbal adjective or a noun. If it is regarded as a noun the word should be written 'Laughing-thrush'; if an adjective, 'Laughingthrush' or 'Laughing Thrush'. [See Rule B (1)]. I favour 'Laughing-thrush'.

(ii) Where a proper name is used, as in the examples that follow, the hyphen should be omitted and the words written separately each beginning with a capital letter, thus:

Nicobar Pigeon, Sarus Crane, Shahin Falcon.

B: ADJECTIVES

(1) A single qualifying adjective should be written, as in common practice, apart from the noun, e.g. Rosy Pastor, Green Loriquet.

Exceptions would be those which usage has joined and no man can now put asunder, e.g. Bluechat, Greenshank, Redshank, Whitethroat, Bluebird.

(2) Where there are two qualifying adjectives, I am of the opinion that they should be written together, thus:

Whitebellied Sea-eagle, Bluetailed Bee-eater, Whitebreasted Water-hen, Whitecollared Kingfisher.

(3) Where the description requires the use of more than two words, clarity requires the use of hyphens, thus:

Black-and-Yellow Grosbeak, Black-and-Orange Flycatcher.

In submitting the above proposal, I realise that rules have an awkward way of producing exceptions and keys have a habit of opening more than one lock. It is also realised that a certain amount of arbitrary procedure goes into the forming of these 'rules', although careful attention has been paid to usage. It is submitted, however, that some consistency in the writing of popular names is desirable and a beginning in that direction ought now to be made.

BOMBAY, W. T. LOKE
November 4, 1951.

25. BULL FROG (*RANA TIGRINA* DAUD.) PREYING UPON THE COMMON TOAD (*BUFO MELANOSTICTUS* SCHNEID.)

A captive specimen of a well-sized *Rana tigrina* Daud. swallowed two adult *Bufo melanostictus* Schneid., its fellow captives. There was an interval of 15 days between the two feeds.

The above specimens were kept in the museum's workrooms and intended for modelling. They were daily fed on cockroaches (*Periplaneta* sp.).

BOMBAY, V. K. CHARI
December 14, 1951. *Asst. Curator*

26. NOTES ON THE BIONOMICS OF THE RED GOBY, *TRYPAUCHEN VAGINA* BLOCH & SCHNEIDER

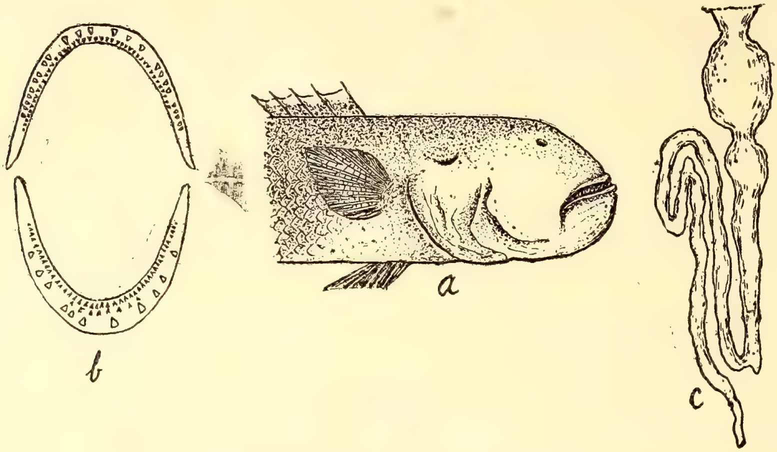
(*With a text figure*)

In his account of the Gobioid Fishes of the Gangetic Delta, Hora (1936) described the ecology and bionomics of ten species of gobies from the Uttarbagh area on the Piali river, one of the estuarine creeks a few miles on a motorable road from Calcutta. He referred to *Trypauchen vagina*, but, since specimens of this species were not available to him at Uttarbagh, its ecology and bionomics were not dealt with by him. The writer was, however, lucky to obtain specimens from the Calcutta markets and Port Canning, about 20 miles south of Calcutta, and also from the fixed engines or Chinese dip-nets operated at the mouth of the Cochin Harbour on the West Coast. As our knowledge of the bionomics of this species is meagre, the following observations seem worth recording.

Trypauchen has a wide distribution, extending from the Persian Gulf, along the coasts of India, to the Indo-Australian Archipelago and China. Koumans (1941) has given a list of localities whence this species has been recorded from India. It is generally found frequenting the coasts, estuaries and lower courses of brackish water streams, canals and creeks. Though essentially a euryhaline species, it is occasionally found to push its way up rivers into waters that are nearly or quite fresh.

Its zonation in relation to the other estuarine Gobioids is similar to that described for *Taenioides rubicundus* (Hamilton) by Hora (1936,

p. 849). It is found living low down on muddy banks between tide marks and in outlying shallow portions. It moves about by wriggling in the mud.



Trypauchen vagina Bloch & Schneider.
(*a*) Lateral view of head and anterior part of body.
(*b*) Upper and lower jaw showing arrangement of teeth.
(*c*) Alimentary canal.

The mouth of *Trypauchen vagina* is superior and oblique, the lower jaw being very prominent (figure *a*). Both jaws are fringed with two or three rows of teeth, of which the outer row is sharp and caninoid (figure *b*). Behind the rows of teeth in either jaw, a membranous flap is present. The markedly upturned nature of the mouth may help the fish to respire even while completely hidden in the mud, with only a part of the head showing in the water. The wide and unspecialised gill-openings suggest that the fish breathes continuously and can pass out muddy water without clogging its gills. Due to its oblique nature, the mouth offers least hindrance to progression through the mud. In correlation with its mode of life in the muddy waters, the eyes have also undergone considerable reduction and, in some of the specimens, are hardly recognisable. On either side above the operculum is a cavity or blind pouch, which is probably sensory in function. The pelvics, which are jugular and partly fused to the ventral surface of the body, are also reduced to a certain extent.

The alimentary canal, which is slightly convoluted, showed practically no variation in the nature and disposition of the coils (figure *c*). The length of the gut roughly ranges from 0.4 to 0.6 in the total length of the fish. The stomach is only 1/10th to 1/12th in the length of the alimentary canal. The short nature of the alimentary canal is suggestive of a carnivous diet. The inner wall of the stomach is produced into a number of longitudinal ridges or folds. In some specimens, the stomach was empty though the intestine had digested food in it. This suggests that feeding is not only intermittent, but that the digestive action is also rapid.

The stomach contents of 36 specimens of *T. vagina* were examined and it was found that the fish feeds mainly on Polychaete worms. Along with the semidigested food, plenty of sand particles were also present. The sand may probably have been derived from the Polychaete worms on which the fish feeds. Bits of algae were found in the stomach of two of the specimens. As none of the other specimens examined showed any trace of phytophagous remains, its stray occurrence suggests that it had been accidently taken in along with other food.

Of interest is the fact that in the stomach of one of the specimens measuring 128 mm., an entire young *Ophichthys*, about 58 mm in length, was found. That the prey had been taken in a short while prior to the capture of the fish is certain, because no digestive action seems to have taken place. It is likely that the prey had been swallowed when both fish were in the net together.

The approximate percentage of food in the specimens examined is as follows: Polychaete remains 65%; digested pulpy mass 20% and sand particles and other food 15%.

It may therefore be surmised that *Trypauchen* frequents muddy areas and is carnivorous in habit, feeding mainly on Polychaete worms.

ZOOLOGICAL SURVEY OF INDIA, E. G. SILAS
CALCUTTA.

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27. TWO FURTHER CASES OF OBSTRUCTION OF THE MOUTH OR THROAT BY FISH

The recent report by B. K. Behura and M. A. John on 'A Curious Death of a Snake' [*J.B.N.H.S.* Vol. 50 (1); 183] reminds me of two other instances in which fish that were too large to be swallowed or subsequently disgorged were taken into the mouth.

In 1942, while the guest of a local rancher near Tampico, Mexico, I noticed that one of my host's dogs was acting strangely. He examined the animal and found that it had a large fish lodged in its throat. This class of Mexicans generally owns numerous dogs for hunting and other purposes, but the animals can scarcely be classed as pets. They are fed irregularly, if at all, so that they must forage for what they can find. The ranch was on the banks of the Panuco River, and apparently the fish had been washed ashore dead or dying. The ravenous dog had not taken time to gnaw the fish but had taken it in entire.

The rancher was unable to dislodge the fish, as it had been ingested head foremost, and various backward-directed spines were wedged into the tissues of the throat. These tissues were already grossly infected, and it seemed that under the conditions there was no choice but to shoot the dog. My host was unwilling for me to 'waste' a shot, however, and since it was his animal I was unable to do more than sympathise with the suffering beast. The dog lingered about the ranch house for four or five days, until one morning it suddenly arose, tottered for a few steps and fell dead.

The second case did not come under my personal observation, but I heard its details in 1949 in Tampa, Florida, and have no reason to doubt their truth. In this instance a Brown Pelican, *Pelecanus occidentalis occidentalis*, had dived for a large fish and succeeded in obtaining it in its pouch. The fish was too large to be swallowed. The pelican was unable to disgorge the fish, for the dimensions of its prey were greater than the widest degree to which the bird could spread its flexible mandibles. Apparently the force of the dive and the impact with the fish were great enough to over-distend the mandibles, but the pelican could not work up an equal counter force to eject the fish.

After the bird had spent several days at one spot on the water, being unable to arise in flight and also acting in abnormal fashion, its behaviour aroused the curiosity of some local fishermen. They were able to capture the bird. Charged with humanitarian instincts, they removed the fish from the pelican's pouch and released the great bird. It was weakened from hunger and could not launch itself in flight. The fishermen left the bird to its natural reactions, and the next day it had disappeared. Whether it recovered from its experience or had died no one knew.

Now some one else must take up the thread of these fish stories.

BANGALORE, C. BROOKE WORTH
November 5, 1951.

28. USE OF FISH SLIME IN STRUCTURAL ENGINEERING

Fish by-products such as fish liver oil, fish meal, fish manure, isinglass, glue, and a host of others are fairly well known. What is perhaps not so well understood is the use of fish slime or mucus for extra strength in the construction of big buildings.

The mucus in question is the one obtained from the body of *Ophicephalus* spp.—'Braal' (Malayalam). Generally the bigger varieties such as *O. striatus* and *O. marulius* are used. The mucus is obtained in the following way: Living specimens are put into a large mouthed copper vessel (about 5 ft. in diameter and 1 ft. in height) with water. The quantity of water is determined with reference to the number of specimens available. Three or four specimens with every gallon of water gives the proper quantity of glue. The fish are kept in the vessel for two or three days. Their movements in the limited quantity of confined water causes the slime on their bodies to enter into solution with the water. This solution is viscous and sticky. A certain amount of the slime settles down at the bottom. This assumes a dull greenish hue. When the solution is found to be sufficiently sticky the specimens are removed, and the solution stirred well. Locally this mucus solution is known as *'Braal pascha'*.

When available in large quantities fish slime is used in the preparation of mortar or in plastering. Structures built with mortar prepared in this way have an extra adhesive strength and do not give way under ordinary conditions. In the construction of domes and other arched structures, *Ophicephalus* mucus is of special importance. It is said that many of the old churches in Travancore-Cochin with arches and domes were built using *Ophicephalus* mucus. The use of this is not so common now as of old, presumably because *Ophicephalus* specimens are not obtained in sufficient numbers for large scale constructions.

Ophicephalus is considered excellent eating all over India. It forms the mainstay of the natural pond fishery in South India. It is cultured in several parts of India and is esteemed as excellent food for convalescents.

EX-FISHERY TRAINEE,
CENTRAL INLAND FISHERIES RESEARCH STATION,
BARRACKPORE, A. C. ANTONY
November 12, 1951.

29. SWARMING OF BUTTERFLIES

While out in the jungle the other day, in hilly country some 60 miles NNW. of Madras I came across enormous swarms of a lycenid butterfly. They were settled along two miles of a red earth forest road in such profusion that there were large patches of grey all over the road.

I estimated there were some patches 10 yards long by the whole width of the road which was about 10 ft. wide, and each patch must have contained tens of thousands of butterflies.

The road was dry but not dusty and there had been rain the week before.

I enclose a specimen of this butterfly and would be very grateful if you will identify it for me.

Incidentally there were smaller patches of other butterflies in the vicinity, notably *Graphium nomius nomius* (twenty to thirty in a group), *Graphium doson eleius, Catopsilia crocale, Appias libythea libythea,* and *Papilio demoleus demoleus.*

In the same place last year in September I came across enormous numbers of *Papilio polytes romulus* ♂♂ all drinking on damp ashes. On this occasion I flopped my net on one patch and caught 57!

c/o GRAHAMS TRADING CO. (INDIA) LTD.,
310/11 LINGHI CHETTY STREET, A. E. G. BEST
MADRAS,
July 27, 1951.

[The specimen has been identified as *Chilades laius laius* Cr., the Lime Blue. It has a practically overall Indian distribution.—EDS.]

30. A CASE OF HETEROPHYLLY IN *ASTERACANTHA LONGIFOLIA* NEES.

Heterophylly is a characteristic feature exhibited by certain aquatic plants as well as a few land plants. It has been explained that the ribbon shaped or finely divided submerged leaves of amphibious plants represent youth forms and may not be regarded as adaptations to the surrounding medium.

An interesting case of heterophylly in the seedlings of *Asteracantha longifolia* (a plant common in wet places such as rice fields, margins of tanks etc.) has recently been observed by the present writer. The leaves of this plant are described as entire in text-books and Floras. In my material the youth forms are broader and deeply dissected while those that follow later are narrower with a fairly uniform leaf-margin. There is no mention of this fact in Arber's Water Plants.

BIOLOGY DEPARTMENT,
GUDIVADA COLLEGE, GUDIVADA, B. S. M. DUTT
November 29, 1951.

31. AN UNUSUAL CASE OF VIVIPARY IN *RHIZOPHORA MUCRONATA* LAMK.

(*With a plate*)

Vivipary is a fixed rule in *Rhizophora mucronata* Lamk. presumably owing to its adaptation to the peculiar mangrove habitat. Under normal conditions only one hypocotyl emerges out of the fruit and hangs down to a length of about 20 inches.

During our exploration of the mangrove vegetation at Pichavaram certain cases were met with where the fruits had two hypocotyls. The occurrence of such unusual specimens no doubt is very rare; rarity being judged from the fact that after a close search spread over two years only ten such specimens have been found. Recently, during one of the trips a single specimen was found with three hypocotyls, hitherto unrecorded.

The anatomy of these viviparous fruits does not appear to have been worked out so far. It is this aspect of study which is particularly presented in the present communication.

Normal viviparous fruits (Figs. 1 & 2): The plumule is capped by a cotyledon, lined by a thick tissue gauzed with reserve food material shaped like a phrygian cap.

Unusual viviparous fruits with two hypocotyls (Figs. 3 & 4): Kumar and Joshi[1] described a similar phenomenon in 1942 in *Rhizophora mucronata* Lamk. but they have not given any anatomical details.

This unusual case under reference is beyond doubt a fruit with 2 seeds which have germinated *in situ* simultaneously in a viviparous manner. The two plumules are separately capped (Fig. 3), by their own phrygian

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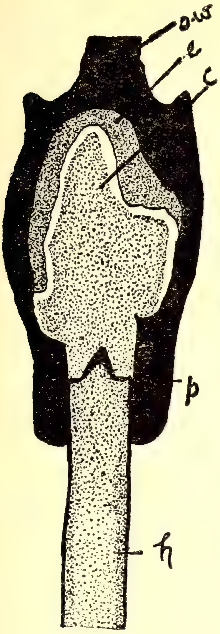
[1] Kumar, L. S. S. and Joshi, W. V. (1942): False poly-embryony in viviparous *Rhizophora mucronata* Lamk. *Current Science* **2** (6): 242.



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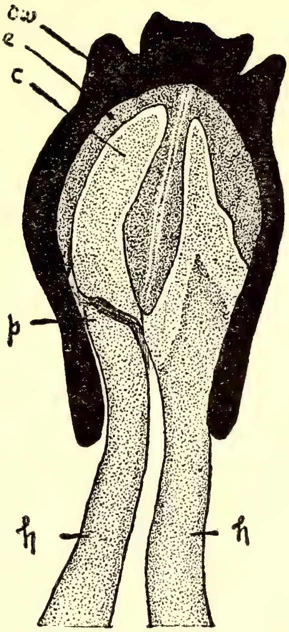

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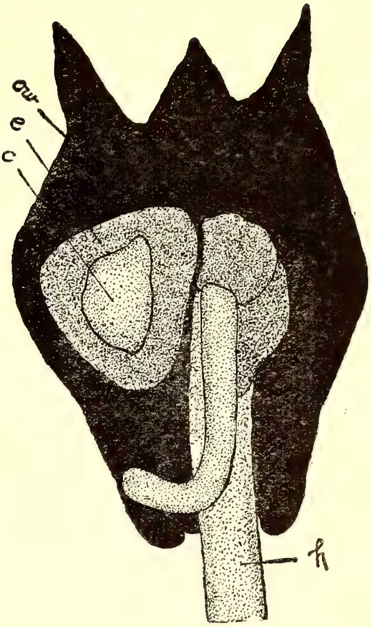

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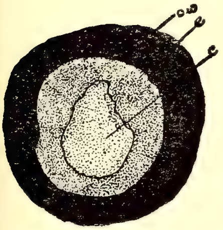

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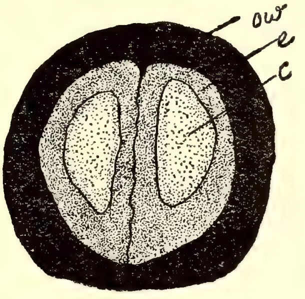

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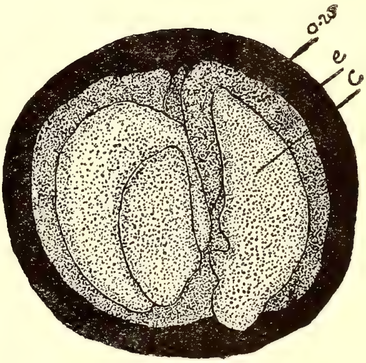

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EXPLANATION OF FIGURES

(c = cotyledons; e = endosperm; h = hypocotyl; ow = ovary wall; p = plumule).

Fig. 1. *Rhizophora mucronata* Lamk.: longitudinal section of a normal viviparous fruit. ×2.

Fig. 2. *Idem*: transverse of the normal viviparous fruit as seen in figure 1. ×2.

Fig. 3. *Idem*: longitudinal section of an unusual viviparous fruit with the two hypocotyls. Note two separate cotyledons on each plumule, covered by the endosperm. ×2.

Fig. 4. *Idem*: transverse section of the unusual viviparous fruit as seen in figure 3. ×2.

Fig. 5. *Idem*: longitudinal section of an unusual viviparous fruit with three hypocotyls (left one broken in transit). ×2.

Fig. 6. *Idem*: transverse section of an unusual viviparous fruit as seen in figure 5. ×2.

capped cotyledons gauzed with reserve food material as in normal specimens.

Unusual viviparous fruits with 3 hypocotyls (Fig. 5): Such an unusual viviparous fruit had not been observed before. The fruit is comparatively big. One of the hypocotyls had broken off in transit. The three plumules are separate and each one of them is independently capped with its own cotyledon gauzed with reserve food material (Figs. 5 & 6).

Grateful thanks are due to Professor T. C. N. Singh, D.SC., F.B.S., Professor of Botany, Annamalai University, for his valuable criticisms and suggestions in the preparation of this paper.

DEPARTMENT OF BOTANY,
ANNAMALAI UNIVERSITY,
ANNAMALAINAGAR,
November 27, 1951.

V. R. RAJAGOPALAN
A. T. NATARAJAN
Research Scholars

32. REPLACEMENT OF INFLORESCENCE BY TURIONS IN *CALDESIA RENIFORME* MAKINO.[1]

(*With a plate and* 3 *text figures*)

Turions, which were regarded as adaptations of the plant to tide over the cold season, and to ensure vegetative propagation have been shown to be the result of unfavourable conditions by Goebel (1891-1893). And the relation which these turions bear to the flowers and inflorescence is of interest. Glück (1906) has recorded the production of an ordinary turion at the apex of an inflorescence which had become submerged. In Alismaceae and some other hydrophytes the connection between flowering and vegetative reproduction is well shown (Arber, 1920; p. 224). In *Echinodorus ranunculoides* (Alismaceae) a plant of America and Africa, transitions between inflorescence and vegetative offshoot occur. And in *Caldesia parnassifolia* (Alismaceae), which is widely distributed in Southern Europe, the inflorescence may be transformed into an axis bearing turions. According to Glück as referred to by Arber the transformation of inflorescences into vegetative shoots takes place as the depth of water increases.

Caldesia reniforme Makino. (=*Alisma reniforme* Don.) is a plant that is widely distributed throughout the plains of India, and ascends to 5,000 ft. in Kashmir and Kumaon. In a number of specimens of *Caldesia reniforme* that were collected by the author from a tank in Bhadgaon in Nepal this year (1951) in early May, the turions have replaced the flowers on the floral axis either in part or completely. As *Caldesia reniforme* is quite common in India, and the occurrence of turions in this species has not been reported so far, the author thinks it proper to describe them. Interest also lies in that the present observations support the view that with the increase in the depth of water the inflorescence is progressively transformed into vegetative turions. The complete transformation of the inflorescence into an axis bearing turions in this species is exactly as occurs in *Caldesia parnassifolia*.

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[1] Makino in *Bot. Mag. Tokyo* 20: 34, 1906.

It is quite necessary to give, in brief, the ecological conditions under which the plants were growing. The tank which is about 650 ft. in length and 300 ft. in breadth is approximately 20 ft. deep in the middle. Towards the margin the depth gradually decreases, as the sides are bounded by steps. The tank supports a *Caldesia reniforme*—*Utricularia* sp. association, with the rare occurrence of a *Hydrilla*. The vegetation is 3-4 ft. away from the sides of the tank. The water is very clear and is used by the populace for washing and bathing, and this may be the reason for the vegetation being away from the sides of the tank. The vegetation is not very dense, and near the fringes the plants are sparse. On April 4, 1948, when the author first visited Bhadgaon and collected specimens of the species the association was the same and he did not come across any specimen with flowers or turions. It is, thus, quite evident that the flowering time for the species in this part of the Himalayas is somewhere about the middle or end of April; and is, consequently, much earlier than the flowering time in Kumaon, where it is in June.

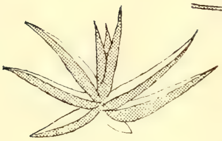


FIG. 3

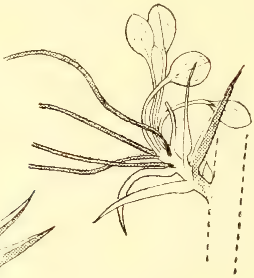


FIG. 4

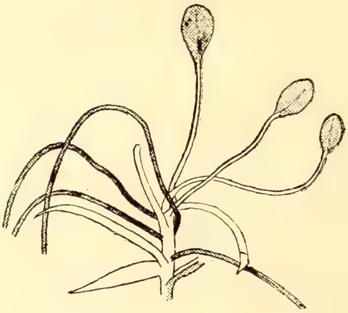
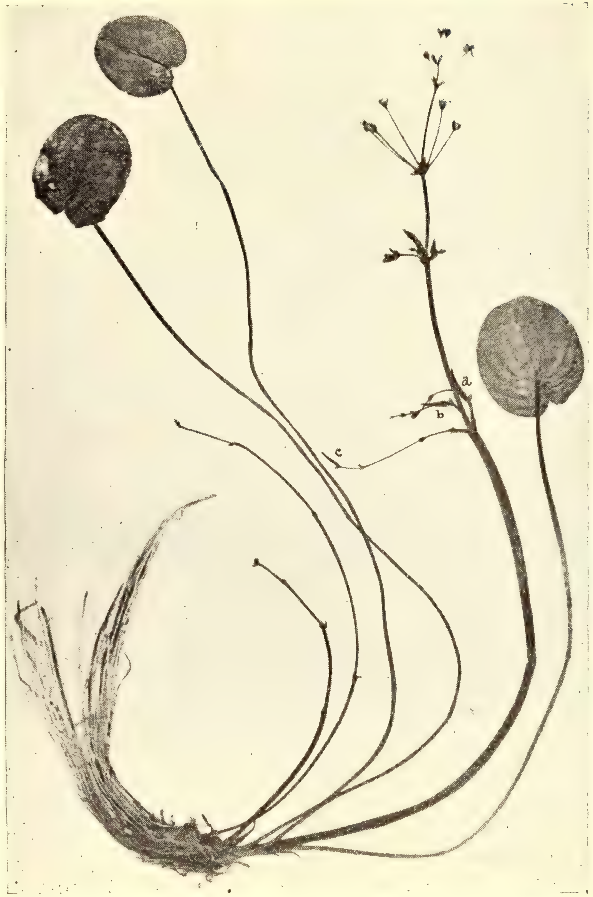


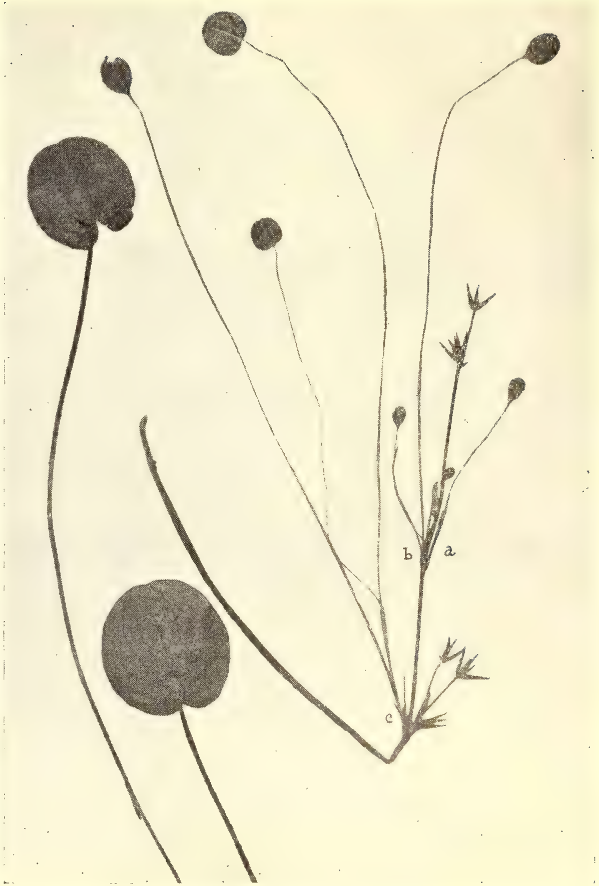
FIG. 5

Caldesia reniforme

The flowers are in large whorled panicles. In photo 1 the inflorescence bears normal flowers at the top of the floral axis and in the lower portions of the axis, the flowers have been replaced by turions (a, b and c). In photo 2 the complete replacement of the flowers by turions all over the main axis has taken place. Some of the turions have sprouted as well (a, b and c). The structure of each turion before it sprouts consist of a short axis on which scale leaves are alternately arranged (Fig. 3). The number of scale leaves on each turion varies from 6 to 10, but commonly there are 8 or 9 of them. The basal scale is always the smallest and approximately of the size of a normal sepal. The other scales are gradually bigger. The turions sprout even when they are still attached to the main axis (Photo 2 a, b and c). But the largest number of sprouted turions collected have been those which had separated from the parent plant. In some cases the main axis begins to rot from the base with the result that the turions attached to the detached axis begin to sprout



1. Showing normal flowers and turions on the inflorescence axis.



2. Showing turions, some of which have sprouted.

and form roots (Fig. 4). Normally a sprouted turion bears roots from the middle of its axis and normal foliage leaves are developed at the apex (Fig. 5). In turions, that sprout when attached to the healthy main axis, roots are not developed early.

For valuable suggestions and criticisms the author is deeply indebted to Dr. V. Puri, who has been the source of encouragement.

BOTANY DEPARTMENT,
MEERUT COLLEGE, M. BANERJI
November 1, 1951.

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[1] As referred to by Arber in 'Water Plants', originals being not available to the author.

NOTES AND NEWS

We regret to announce the death on 24 March at his home in Tunbridge Wells, England, of Mr. W. S. Millard, one of the oldest members of the Society and its Honorary Secretary from 1906-1920. A fuller obituary note will appear in our August number.

* * * *

At the invitation of the President of the International Committee for Bird Preservation, the Government of India have set up a National Section for Bird Preservation, (vide Gazette Notification No. 22 (3)/51 SRII dated 17th December 1951) to assist the international body in its objective of stimulating active interest for more adequate protection of India's bird life. Government have directed that the national committee shall function under the aegis of the Bombay Natural History Society and maintain international contacts through the Ministry of Natural Resources and Scientific Research, New Delhi.

The constitution of the committee is as follows :

1. Mr. Sálim Ali (*Chairman*)
2. Mr. E. P. Gee, Assam
3. Dr. Satya Charan Law, Calcutta
4. A representative of the Forest Research Institute
5. A representative of the Zoological Survey of India
6. A representative of the Zoological Society of India
7. Mr. C. E. Hewetson, Conservator of Forests, Bastar, Madhya Pradesh
8. Mr. Horace Alexander, Delhi
9. Two university professors of zoology, each to be nominated by the National Institute of Sciences of India and the Inter-University Board respectively.

It is a matter for gratification that the Society's services in the cause of bird protection in India have received official recognition in this manner, and it is to be hoped that the national committee, with the co-operation of the international body, will further help in intensifying and making more effective our efforts. There is urgent need for action in the case of several bird species and habitats which are threatened with extinction or with unwise over-exploitation to the detriment of their native bird faunas.

The Indian National Committee expects to hold its first meeting shortly when plans for priorities and action will be discussed. Reports will be published in the *Journal* from time to time.

* * *

Negotiations with the Central Ministry of Finance (Revenue Division) have resulted in Government's approving of the Society for purposes of Section 15-B of the Indian Income-tax Act 1922. This in essence means that donations to the Society of amounts not less than Rs. 250 will be exempted from income-tax subject to the aggregate of any such sum not exceeding 1/20th in the case of a company and 1/10th in any other case of the assessee's total income, or Rs. 2,50,000 whichever is less. The Executive Committee hopes that well wishers of the Society will find in this concession just the opportunity they have been waiting for to make substantial donations to the Society's funds and assist thereby not only in furthering its current activities but also in building up an adequate reserve for the future.

ERRATA

THE HILSA FISHERY OF THE CHILKA LAKE

[Published in Vol. 50(2)—December 1951]

Page	*Line*	*Read*	*For*
266	6	Tua side	Tuaside
268	Graph II ...	Graph II. Showing trend (i.e. continuous rise or fall) of flood levels in the Kathjuri (branch of the Mahanadi), over the crest level of the Naraj Anicut in the years 1948 and 1949.	Graph II. Showing rainfall over the Chilka region in the years 1948 and 1949. (Average of Gopalpur, Khurda and Puri.)
269	Graph III...	Showing rainfall over the Chilka region in the years 1948 and 1949 (Average of Gopalpur, Khurda and Puri).	Graph III. Showing trend (i.e. continuous rise or fall) of flood levels in the Kathjuri (branch of the Mahanadi), over the crest level of the Naraj Anicut in the years 1948 and 1949.
279	Para I Last sentence.	The success of this measure in a rather out of the way place is not an easy task, but the experiment may be worth trying and its long range effect worth studying.	The success of this measure, in a rather out of trying and its long range effect worth studying.

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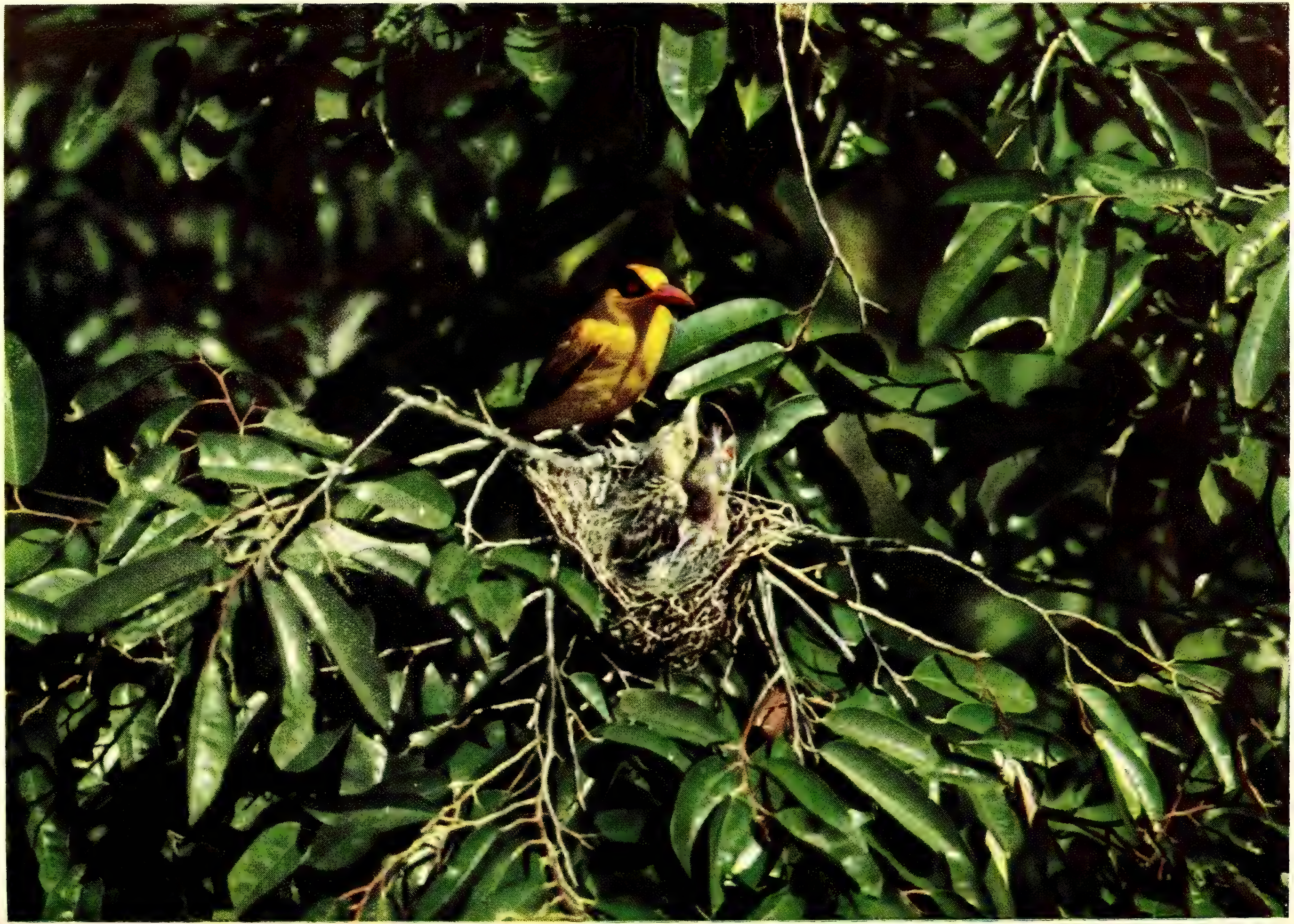

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EDITORIAL

The Society's *Journal* which has maintained uninterrupted publication for the last 66 years completes its fiftieth volume with the present issue. This surely is an occasion for justifiable pride. From small beginnings—four parts of Vol. I published in 1886 contained only 234 pages —it has grown to imposing proportions, the average number of pages in the last 10 volumes being 774.

For a natural history publication conducted by a private society purely out of revenues derived from its membership subscriptions, with practically no financial aid from Government or extraneous sources, this is indeed a praiseworthy achievement. Add to this the general lack of interest in natural history in India that had to be contended with for keeping up the Society's membership strength, also the fact that contributions for publication were gratis and voluntary and therefore not always to be depended on—and the achievement becomes doubly creditable.

The contributions to the *Journal* at first consisted largely of sporting and popular articles written mostly by members of the Society who were generally observant sportsmen and field naturalists—'amateurs' it is true, but in the best sense of the term. The scope of these contributions has steadily expanded, and serious scientific papers by acknowledged experts have now become a regular feature of its pages.

Finally, the fact that throughout the years the editors of the *Journal* have all been entirely honorary—business or professional men with plenty of enthusiasm but limited time at their disposal—is not the least notable feature of this remarkable achievement.

The membership of the Society does not consist of scientific men alone, nor does it consist of sportsmen pure and simple, nor altogether of persons who look upon natural history merely as an amusing pastime. It is a conglomerate of all these types. And this is not all, for while readers of the *Journal* include some who are mainly interested in large game animals, the interest of others centres chiefly on plants or snakes or butterflies or birds. Every branch of the study of animal or plant life, moreover, has its devotees among them. Some are interested in problems of evolution or systematics and taxonomy, others in field study and ecology, others in morphology and laboratory experiments, others in economics and applied biology or some other line of study, and yet others in shooting, fishing or nature photography. The effort to cater for all these polyglot tastes makes the task of editing the *Journal* one of absorbing interest, but by no means easy. The problem always is to maintain the golden mean, and the difficulties involved in the effort are such as the casual reader can have but a vague conception of. Since the journal does not pay for contributions, it is seldom in a position to pick and choose material to any large extent; nor is it always possible to publish articles strictly in rotation as they are received. Such delay sometimes causes dissatisfaction among contributors, and in some cases, where, for instance a new species is described, deferred publication may even constitute a genuine grievance. It may happen that one particular issue contains a preponderance of articles on birds, or plants or fish or what have you; or it may contain more articles on systematics or morphology—'dry-as-dust' as they are commonly dubbed—than perhaps the average reader or field student cares to be inflicted with. A howl goes up immediately. One member complains that the *Journal* is getting much too 'high brow' for a simple nature lover like him and therefore writes in to 'Please accept his resignation from the Society'! Another member complains of a following issue that the *Journal* has descended to the level of a story-telling magazine and is no longer a truly scientific publication, therefore he feels constrained to dissociate his good name from it! And so it goes. One finds in the journal too much of fish and too little of birds; another too much morphology and too little natural history; and the charges of similar excesses and deficiencies levelled at the editors are without end. Our sins of omission and commission are indeed bewildering! But they are not new, and that the *Journal* has survived them during the last 60 years, and even grown from strength to strength to enjoy the high esteem of scientific workers throughout the world would seem abounding proof that it has, on the whole, been conducted along the right lines. This is, of course, not the same thing as saying there is no room for improvement; the editors are the foremost to realize this. There are indeed certain directions in which the scope and desirability for improvement are quite obvious. For instance, we could easily do with more coloured plates for the general reader and nature lover, and also with more original and snappy articles on shikar, scientific expeditions and the out-of-doors generally. There is no doubt that these would help substantially in widening the appeal of the *Journal* and help to develop greater general interest in nature. But within the limits imposed by hard facts, it is almost as much as we can do at present to keep going.

Although it is gratifying to find that among the eight original founders of the Society two were Indians, the lion's share of the credit for what it has achieved must nevertheless, go where it belongs. It was really British members of the business community and services who, through their keenness on sport and natural history, enabled the *Journal* to be born and to survive and flourish.

Scanning the earlier volumes for names, one finds that the first Indian contributor to the *Journal* was Surgeon-Major K. R. Kirtikar, I.M.S., whose studies on 'The Poisonous Plants of Bombay' published serially in 20 parts, led the way to his well known 'Indian Medicinal Plants', written jointly with B. D. Basu. Revised by the late Fr. J. F. Caius, S.J., one of the later editors of the Society's journal, and published in four volumes, this is still a standard work of reference.

The number of Indian contributors has risen from five in the first 15 volumes to well over 120 in the last 15. They have now largely taken the place of British in plants, insects and fishes, on all of which subjects there is a steady inflow of papers for publication, many of them of a high scientific standard. Contributions on other branches of animal life and, particularly, articles on shikar and general natural history are not of equal volume. Fortunately, we still have in our midst a number of British sportsmen and field naturalists upon whom the editors can always rely when material in lighter vein and free from scientific technicalities is needed to vary the ponderous diet of 'dry-as-dust' specialized fare. Although our countrymen may number many mighty slayers of tiger and other big game, equalling and even surpassing British sportsmen of the past, so far there are scarcely any known to us who, through love of the jungles and intimate study of the ways and habits of wild animals, can wield gun and pen with the dexterity of such sportsmen-writers of the past as J. D. Inverarity or Reginald Gilbert.

A passage from the Introduction to the very first issue of the *Journal* (Vol. I, No. 1, January 1886) seems worth quoting, since what was true then is perhaps even truer to-day: 'In accordance with the character which this Society has assumed from the beginning, the aim of its journal will be, as far as possible, to interest all students of nature, ever remembering that there are many naturalists, in the highest sense of the term, who have not such a technical knowledge of any particular branch of science as to be able to enter with interest into questions of nomenclature and the discrimination of closely allied species. The Secretaries of the Sections would therefore invite sportsmen and others to communicate anything interesting or worthy of note, which comes under their observation, bearing on the nature and habits of animals and plants.'

Papers on birds have in the past consisted largely of regional lists, but the recent happy trend of laying greater emphasis on physiography, habitat and ecology, and detailed field notes on individual species, has helped to impart more life to the pages of the *Journal* and added to their usefulness for students. The increasing use of Champion's 'Forest Types of India and Burma', constantly advocated by the editors for fixation and description of biotopes, has tended in some measure, to minimize diffuseness in the terminology employed by workers in different branches of animal and plant life. Champion's system was primarily devised for foresters, but experience shows that there is real scope for simplifying and perfecting it for the general use of field naturalists possessing but little technical knowledge. Since scientists have to depend so largely for their data upon objective field observations of the so-called amateurs, the importance of a standard designation of habitats will be readily appreciated.

Departments in which the *Journal* is to-day poorer than in the past—besides sport and field natural history—are perhaps Herpetology (in which we led during the era of Col. Frank Wall, I.M.S.) and Mammals, of which, except for some of the larger and more spectacular game animals—our knowledge of their habits and life histories remains lamentably deficient and static.

While on the subject of contributions and contributors it seems pertinent also to refer to the past editors of the *Journal* who laboured so devotedly for its growth and development, and won for it the important place it now occupies among scientific journals of the world. All honour and praise to those men for the traditions they have built up. They have set high standards, and though it may be difficult to maintain them, these will ever serve as an inspiration to their successors and an ideal towards which to strive. The trail has been clearly blazed for us, and if the same type of co-operation as our predecessors enjoyed from members and contributors is forthcoming now, we are confident that our task of maintaining the level of achievement will be considerably lightened.

THE EDITORS' WHO'S WHEN

A scrutiny of the *Journal* for the names associated with the editing of the 50 volumes, from its inception in 1886 to the present day, reveals as follows:

Vols. I-II (1886–7): R. A. Sterndale & E. H. Aitken.
,, III-XI (1888-97): H. M. Phipson.
,, XII-XVI (1898-1904): H. M. Phipson & W. S. Millard.
,, XVII (1907): W. S. Millard, E. H. Comber & L. C. H. Young.
,, XVIII-XXVI (1907-1918): W. S. Millard, R. A. Spence & N. B. Kinnear.
,, XXVII-XXIX (1920-23): R. A. Spence, B. C. Ellison & S. H. Prater.
,, XXX (1924): R. A. Spence, P. M. D. Sanderson & S. H. Prater.
,, XXXI (1926): R. A. Spence, & S. H. Prater.
,, XXXII (1927-8): R. A. Spence, P. M. D. Sanderson, S. H. Prater & Sálim Ali.
,, XXXIII (1928-9): R. A. Spence, S. H. Prater & Sálim Ali.
,, XXXIV-XXXV (1930-32): R. A. Spence & S. H. Prater.
,, XXXVI-XXXVII (1932-34): R. A. Spence, P. M. D. Sanderson, S. H. Prater & C. McCann.
,, XXXVIII-XL (1935-39): P. M. D. Sanderson, S. H. Prater, C. McCann, H. M. McGusty & J. F. Caius.
,, XLI-XLIII (1939-43): H. M. McGusty, J. F. Caius & S. H. Prater.
,, XLIV (1943-44): J. F. Caius, S. H. Prater & C. McCann.
,, 45-47 (3) (1944-48): S. H. Prater, C. McCann & Sálim Ali.
,, 47 (4)-48 (2) (1948-49): Sálim Ali & S. B. Setna.
,, 48 (3)-50 (1949-52): Sálim Ali, S. B. Setna & H. Santapau.

Happily, as will be seen, we have never had to suffer a clean break in the chain of editors, so that there have always been one or more in a new combination sufficiently familiar with the conduct of the *Journal* to permit of smooth continuity. This circumstance has helped appreciably in the maintenance of its general policy and traditions.

THE EDITORS' WHO'S WHO

1. Edward Hamilton Aitken, better known as EHA, hardly requires introducing. As author of several books which have become almost classics, he enjoys a wide reputation as a naturalist. 'Behind the Bungalow', 'Tribes on my Frontier', 'A Naturalist on the Prowl' and 'Common Birds of Bombay' are amongst his most popular writings. Indeed EHA is claimed by some to be India's greatest naturalist-writer, and a perusal of his books shows that this is by no means an exaggerated view. He was an exceptionally keen observer of nature, interested in everything that lived and breathed and possessed the gift of humorous and imaginative, yet scrupulously accurate, description such as has seldom been surpassed or equalled. When EHA resigned his editorship of the *Journal* in 1887, presumably because of transfer from Bombay, his place was taken by H. M. Phipson who had in the meantime returned from leave in England.

A very good biographical sketch of EHA by W. T. Loke is given in the 3rd ed. of 'The Common Birds of Bombay' reprinted in 1947 by Thacker & Co. Ltd., Bombay, under the altered title of 'The Common Birds of India'.

Sir Norman Kinnear relates that in an obituary notice that appeared on his death in 1909 in a local newspaper of his provincial home town in Scotland, EHA was described as an expert on Indian birds, Bungalow Economy and the Frontier Tribes! How EHA himself would have enjoyed this description can be imagined by any one familiar with the spirit of his writings.

2. Fr. Jean Ferdinand Caius, S.J., a distinguished biochemist, was Professor of Chemistry in St. Xavier's College, Bombay, from 1922, and founder and first director of the Pharmacological Laboratory at the Haffkine Institute (Government of Bombay) from 1924-1932. He became Honorary Secretary of the Society in 1941 and served as Chairman of the Sub-Committee of Trustees of the Natural History Section of the Prince of Wales Museum, and as one of the editors of the *Journal* till his death in 1944. He was an indefatigable worker and among his more outstanding scientific achievements were the intensive investigations he carried out at the Haffkine Institute on the therapeutic value of various remedies employed against diseases caused by hookworm and roundworm, so prevalent in India. His work has been recognised as the most exhaustive and complete treatise on the subject and is widely quoted in most text books on pharmacology. Another contribution by Fr. Caius was his extensive studies of the poison apparatus of snakes and of the remedies employed against snake poisons, particularly those alleged to be efficacious in the Ayurvedic and Yunani systems of medicine. His experiments proved that all of such cures, even those most widely reputed, were completely ineffective against cobra and viper venom.

He contributed a valuable series of articles to the *Journal* on the Medicinal and Poisonous Plants of India, and completed the revision started by the late Fr. Blatter, of Kirtikar and Basu's 'Medicinal Plants of India'.

Fr. Caius died in Bombay in July 1944. A full obituary notice appears in Vol. 45, pp. 79/80.

3. Edward Comber, a partner in the Liverpool firm of East India Merchants, Lyon, Lord & Co., was one of the most active members of the Society in its early years. He was a great yachtsman, and keenly interested in birds and insects though his many notes and articles between Vols. 10 and 20 of the *Journal* cover practically every branch of animal life and reveal the wide range of his natural history interests. Among his contributions is a series 'Hints to Beginners on collecting and preserving Natural History Specimens'—Mammals (Vol. 13; 100), Birds (Vol. 13; 270), Reptiles & Amphibians (Vol. 13; 641) and Fishes (Vol. 17; 396), which by the help they afforded up-country members, were largely instrumental in building up the Society's zoological collections from different parts of the country. Comber was largely responsible for the proper care and cataloguing of the various collections, lists of which he published in the *Journal* from time to time. Also for preparing the first General Index for Vols. I to XII.

Sir Reginald Spence who was Comber's contemporary in the early years, from 1901 on, and until the latter was transferred to Karachi, tells us that he did a lot of work in the evenings after office hours in the Society's rooms at 6, Apollo Street. In fact his wife once wrote to him that she was sure this was bad to him. 'Consider those who work there', she said, 'Mr. Phipson is like a sucked orange, Mr. Millard a bundle of nerves and as for Mr. Spence "why look at him"' ! To which it seems irresistible for one of the present editors to add that Sir Reginald must have looked very different indeed in those days !

4. N.B. (now Sir Norman) Kinnear came out to India in 1907 as the first wholetime curator of the Society. He had had his training in the Royal Scottish Museum at Edinburgh under the well-known ornithologist Dr. William Eagle Clarke, and his advent marked the immediate shift of the Society's activities to a more scientific plane through a proper rearrangement, labelling and cataloguing of its various collections. His staff work in connection with the Society's Mammal Survey was invaluable, and the success of the undertaking is due in no small measure to the care he bestowed on its planning and direction. His main influence on the *Journal* was also in the direction of a greater scientific bias. He encouraged and guided many young people to develop their particular interests in natural history, and several of the names that have since gained prominence in its pages can be claimed to have derived their inspiration largely from Kinnear. He published numerous notes and short articles in the *Journal* on various branches of Indian natural history, and through country-wide correspondence with outstation members elicited a wide range of useful and interesting matter for the Miscellaneous Notes section.

Kinnear's special interest lay in Mammals and Birds, and field study in these two branches received a great fillip whilst he was in the country. Since his return to London he has maintained a lively interest in the affairs and progress of the Society and rendered valuable assistance to it in various ways. He has also contributed important papers on birds of the Palaearctic and Oriental Regions to the *Journal* including the report on the Vernay Scientific Survey of the Eastern Ghats—written in collaboration with the late Hugh Whistler—which, by showing up the many gaps in our knowledge of Indian ornithology led the way to the useful regional bird surveys that have since been sponsored by the Society.

Kinnear left India in 1919 to take up an appointment in the Bird Room of the British Museum (Natural History), London. He rose to be Director in 1948, an eminence from which he retired in 1950.

5. On Kinnear's departure from India, Bernard C. Ellison was selected on behalf of the Society by R. C. Wroughton (who was working in the British Museum on the collections of the Mammal Survey) and sent out as curator to Bombay in 1920. The choice would, on the whole, seem to be an unfortunate one since Ellison—overtly, at any rate—possessed few of the qualifications that might be expected in the curator of a natural history museum or in the editor of a scientific journal. Ill health terminated his contract with the Society early, and he returned to England in 1923.

6. Charles McCann joined the Society as a collector in the Mammal Survey in December 1921 and was appointed Assistant Curator in 1922 and Joint Curator in January 1946. Later in the year he resigned his post and left India.

The minute of the Society's Executive Committee dated 14th November 1946 recording its appreciation of his services and regret at his resignation gives a good sketch of McCann's career. It reads in part as follows:—

'The merit of his scientific work is evidenced in his many biological contributions to the journal of the Society. He is one of the outstanding botanists in India and his monograph on Grasses which he wrote jointly with the late Father Blatter, and which was published under the aegis of the Imperial Council of Agricultural Research, will remain for many years the standard work on the subject. Equally outstanding in merit are his various revisions of the genera and species of Indian plants which the Society was privileged to publish. Mr. McCann also contributed various authoritative papers on Indian Mammals, Reptiles and Amphibia. They are based on careful field work and observations. The study of Nature was his absorbing passion and his main recreation.

In the Museum his services were invaluable, and the galleries of the Natural History Section of the Prince of Wales Museum and the fine range of groups and well-mounted exhibits owe much to his skill and ability. His resignation is a great loss to the Society.'

McCann was indeed a phenomenal field naturalist. His powers of observation were uncanny in their keenness and incisiveness. Nothing escaped his attention as he tramped through the jungles of his beloved Western Ghats. The degree of his familiarity with all living things was such that whether it be plant or rat, bird or snake, lizard or frog, butterfly or snail, he could identify it pat and without hesitation correctly down at least to the genus in nine cases out of ten, and often give you the species as well !

He is now settled in New Zealand and is on the Staff of the Dominion Museum at Wellington.

7. H. M. McGusty was a senior assistant in the firm of Phipson & Co., which has had a traditional unbroken connection with the B.N.H. Society from the time it was founded. He served the Society variously as Honorary Secretary and Honorary Treasurer for several years between 1934 and 1941 when he finally left India. His connection with the *Journal* was, however, purely ex-officio and titular, and he had no active hand in editing it.

8. Walter Samuel Millard who took over from Phipson in 1906, had already been associated with the editorship since Vol. 14 (1903). Millard proved an admirable successor to Phipson, and the period of his stewardship may be called the period of consolidation for the Society, when it expanded widely both as regards membership and usefulness. His most notable contribution to its progress and scientific reputation was the organising and carrying out of the Mammal Survey of India, Burma and Ceylon, a full account of which is contained in Part III (pp. 86-89) of the Society's Jubilee volume published in 1934.

Millard was an expert gardener, and his garden on Malabar Hill is still remembered with pleasure and nostalgic envy by some of the older residents of Bombay. His short notes in the *Journal* cover many branches of natural history, and jointly with Rev. Fr. Blatter he was author of 'Some Beautiful Indian Trees', an attractive well-illustrated book published by the Society in 1937.

Millard left India on retirement in 1920, and it was only the other day the sad news of his death reached us. An obituary notice appears on p. 910 of this issue.

An amusing story is told of Mr. Millard when he was Honorary Secretary. Every afternoon it was customary for the Society's cashier to take the day book in for his inspection and tally of the day's receipts. As soon as Baburao (or whatever his name was) appeared from behind the door, Mr. Millard would look straight into him and solemnly exclaim 'Baburao, I suspect you !' His daily advice to the cashier when they parted was, 'Baburao, each time you make an entry in this book say to yourself "Mr. Millard suspects me", and you cannot then go wrong'.

9. Herbert Musgrave Phipson was a truly remarkable man. During the early years of the Society, Phipson as Honorary Secretary and Editor was its virtual 'Mā-bāp'. It is largely to his keenness and contagious zeal as a naturalist, his devotion to the cause, his untiring enthusiasm and energy, and above all to his wonderful personality that the Society and its journal owe their growth and prosperity. This was the truly formative period, and the firm foundation upon which Phipson built has enabled the Society to weather the storms and stresses of subsequent years.

Phipson's particular interest lay in Snakes and he contributed a great deal to their study; but except for a few short notes he unfortunately published little of his own observations in the *Journal*. He left India in 1906 and died in London in 1936. A good biographical sketch of H. M. Phipson appears on pages 152-154 of Volume 39 (December 1936).

10. Stanley Henry Prater had entered the Society's service in 1907, working first under the guidance of E. Comber and subsequently as assistant to N. B. Kinnear. He was a voracious and discriminating reader, particularly of natural history books in his early years, had the power of assimilating what he read, and was blessed with a remarkably retentive memory. He was a clear and lucid descriptive writer with a pleasant easy style; a good artist and modeller, and dextrous with his hands in other ways. He possessed an almost uncanny aptitude not only for picking up techniques but for passing on what he learnt to his assistants and then getting the best out of them. These qualities, fortified by the practical experience he had acquired and a course of academic grounding in systematic zoology with the late Fr. E. Blatter to provide the necessary scientific background, fitted Prater admirably for taking charge of the Society's museum and journal. Prater's *forte* was his capacity to pick out the essentials of anything he read—of separating the grain from the chaff—and of clothing the substance in clear jargonfree language. Though he would not claim any original achievement in the scientific field, yet there is perhaps no other recent naturalist who has done more to popularize zoology in India. He was a master in the art of compilation. The skill and discernment with which he would browse among heavy scientific literature and the facile way in which he would connect up and expound disjointed facts culled from a dozen sources and produce harmony from them, excited the admiration and envy of less gifted souls. It is but natural that a person possessing all these advantages should, up to a point, dominate his colleagues, and indeed from the time his name first appears on the cover of the *Journal* —Vol. xxvii (1920)—and up to the time of his retirement in 1948 Prater virtually ruled the editorial roost. He had the contents of all the previous volumes at his fingers' tips and could recall everything published on any topic before, by whom and when, and could turn to it without effort or fumbling. His familiarity with the Society's reference library was also such that he knew exactly where to turn for just the information needed. And how most effectively to make use of that information is of course what he excelled in. As a natural historian he was an all-rounder, having had, during his long connection with the Society, the opportunity of working fairly thoroughly through all its collections and acquiring a wonderful general knowledge of the various branches. He could name straightway almost at a glance, most specimens brought in by members of the less uncommon mammals, birds, reptiles, amphibians, fishes, butterflies and many other groups of insects, and could usually tell of their distribution and habits as well. His numerous notes and articles in the *Journal* cover a very wide range of natural history topics. Though not a specialist in any particular branch, he was perhaps more at home with

birds and snakes than with other groups. Yet such was his general grasp and versatility that whatever he chose to write on bore the imprint of authority. Indeed he wrote nothing of doubtful authenticity since all his basic facts were garnered from authoritative sources. His masterly treatment of The Whale Shark in Indian Coastal Waters (Vol. 42; 255) and Fish Supply of the West Coast of India (Vol. 34; 973 & Vol. 35; 77) and The Game Fishes of Bombay, etc. (Vol. 36; 29) are examples. On perusing them it seems inconceivable that they should be written by any but a specialist—so sound and facile are they.

It was largely during the run of Prater's editorship that the Society's journal attained the esteemed position it now enjoys among the scientific periodicals of the world; of course we were fortunate also in our contributors who included an increasing number of workers of distinction in the international field.

Prater retired in 1947 after some 40 years of devoted service to the Society, and now lives in London.

11. P. M. D. Sanderson also of the firm of Phipsons, whose name flicks sporadically on the editorial board first in 1924 (Vol. XXX) and again in 1928 as an editor for Vol. XXXII (4), acted as Honorary Secretary during Sir Reginald Spence's periodic absences on leave in England. He was also one of the old brigade with Millard and Spence who had had their introduction to Indian natural history under Phipson's tutelage. On Spence's retirement from India in 1934, Sanderson took over from him as Managing Director of Phipson & Co. and, in keeping with the long established tradition, more or less automatically stepped in as Honorary Secretary of the Society as well.

Though a keen naturalist and sportsman, and an enthusiastic protagonist of the Society, Sanderson's activities in regard to the *Journal* were more of a general supervisory charactr, and strangely enough the *Journal* carries no article contributed by him. He left India in 1939, and now kindly looks after the Society's interests in the U.K.

12. R. A. (afterwards Sir Reginald) Spence who succeeded Millard, had likewise started his career in India as a young assistant in the wine business of Phipson & Co. He had early caught the contagion of enthusiasm for natural history from his chief, and was nurtured in this interest through Phipson's guiding care. During Spence's long association as its Honorary Secretary, the Society may be said to have attained its flowering. His genial personality won him many friends, and the esteem he commanded both with the public and with Government reflected beneficently on the affairs of the Society. He brought to fruition the negotiations started by his predecessors regarding the transfer of financial responsibility for the housing and proper care of the Society's zoological collections from the Society to the Government of Bombay, and had the satisfaction of feeling the imminent fulfilment of his labours before leaving India in the detailed plans for the completion and utilization of the beautiful new natural history wing of the Prince of Wales Museum, Bombay, which has since come into being.

As editor of the *Journal* Spence was fortunate in having the able collaboration first of N. B. Kinnear, a trained and experienced zoologist lately out from England as the Society's first stipendiary curator, and then, after 1919, of S. H. Prater who succeeded him in office.

Though increasing demands on his time from business and social work caused Spence latterly to leave much of the actual editing to his colleagues, he nevertheless continued to take a lively interest in the welfare of the *Journal* and to guide its general policy.

His outstanding contributions to the *Journal,* both written jointly with Prater, were the articles on 'The Fish Supply of the Western Coast of India' (Part I, Vol. xxxiv; 973, Part II, Vol. xxxv; 77) and 'Game Fishes of Bombay, the Deccan and the Neighbouring districts of Bombay Presidency' (Vol. xxxvi; 29).

Sir Reginald left India on retirement in 1934.

13. Robert Sterndale came to Bombay soon after the Bombay Natural History Society was formed in 1883, and at once joined it and worked for it with his characteristic enthusiasm. The idea of starting a journal originated with him and 'proved practicable only because of the way in which his ready pen and pencil solved all difficulties.' Being an exceedingly keen and versatile field naturalist, he himself contributed many interesting articles and was largely responsible for getting the *Journal* under way. Sterndale is perhaps best known as the author of 'Natural History of Indian Mammalia' which, published in 1884, is still one of the standard reference books. He ended his official career as Governor of the island of St. Helena, and died in 1902.

14. L. C. H. Young who, with E. Comber, was an editorial collaborator of Millard's for Vol. 17, came out to Bombay about 1903 on the staff of the insurance department of Forbes, Forbes, Campbell & Co. He was a Marlborough man, and a keen and knowledgeable lepidopterist, being a disciple of the distinguished entomologist, E. Meyrick, F.R.S., whom he got to write the monumental papers on Indian Microlepidoptera, published between Vols. 18 and 23 of the *Journal.* He reorganised, re-set and re-catalogued the Society's butterfly collection and published several useful notes and papers, chiefly on butterflies, between Volumes 15 and 17 of the *Journal.* About him Sir Reginald Spence writes, 'We called him "Bug" Young. He lived for a time out at Andheri with F. C. Annesley and with me—a quaint man at dinner in a tent with an oil lamp and plenty of flying insects to interrupt his dinner and conversation.' Young did not enjoy good health and had to return to England where he died soon after. The serial on 'The Common Butterflies of the Plains of India' was originally started by Young in Vol. 16. He had to give it up after the first 3 parts owing to ill health. It was taken up by another distinguished lepidopterist-member T. R. Bell, I.F.S., in Vol. 19 who conducted it for 16 years, concluding it finally in Vol. 32.

The Present Editors

1. Sálim Ali has had a long and active association with the Society. His chief interest is birds, particularly the field aspects of their study, and he is the author of several books on Indian birds. He served as one of the editors in 1927-28 (Vols. 32 and 33), and

resumed his connection with the *Journal* in 1944 (Vol. 45), collaborating with S. H. Prater and C. McCann. Upon their leaving India, Sálim Ali took over as General Editor assisted by Dr. S. B. Setna for a year, when Fr. H. Santapau joined the board.

2. Dr. S. B. Setna studied under Dr. J. Gray, Professor of the Zoological Laboratory, Cambridge University, where he obtained his PH.D. degree. He is the Director of Fisheries, Bombay State, since the inception of the department in 1945. In this capacity he is responsible for the development of freshwater and marine fisheries in the State and also for the maintenance of the Taraporevala Aquarium. He was elected a Fellow of the National Institute of Sciences of India in 1947 and was awarded the first Chandra Kala Hora Memorial Gold Medal in 1950 for conspicuously important contributions to the development of the fishing industry.

Dr. Setna has been one of the editors of the *Journal* since 1947 and is chiefly responsible for editing the articles relating to fish and fisheries.

3. Rev. Fr. H. Santapau, S.J., studied at the Imperial College of Science and Technology, London, and in Kew Gardens and specialized in Plant Taxonomy. He is particularly interested in the botany of Western India and has done intensive explorative work in Khandala, Purandhar, Mahableshwar and now in Saurashtra. He is director of the Biology Department of St. Xavier's College, Bombay.

COSTS—THEN AND NOW

A comparison of the cost of printing the journal at different periods of its existence is revealing.

In 1891, all the 4 parts of Vol. VI were published. These included 6 coloured and 10 black and white plates printed in England. The text was printed, as from the commencement, at the Educational Society's Press, Byculla, Bombay. The total cost of the volume came to Rs. 4,316-1-2.

In 1900 all the 5 parts (including Index) of Vol. XIII, together with No. 5 (Index) of the previous volume came out. It contained 10 coloured and 4 black-and-white plates printed in England. The text was printed at the Times of India Press who took over the printing in 1893 (Vol. VIII) and continued it till 1925. The total cost of production that year was Rs. 6,338-7-0.

In 1915 Vol. XXIII, Nos. 3, 4 and 5 and Vol. XXIV, No. 1 with 9 coloured and 22 black-and-white plates prepared in England, and text printed at the Times of India Press, Bombay, cost Rs. 9,308-12-2.

The first number to be printed at the Diocesan Press, Madras—who have been our printers since—was Vol. XXX, No. 3 (June 1925).

In 1930, the first three numbers of Vol. 34 were published containing 10 coloured and 52 black-and-white plates. Of these, all the coloured and a few of the monochrome plates were prepared in England. The total cost came to Rs. 15,562-5-6.

In 1950, Nos. 1, 2 and 3 of Vol. 49 appeared together with Index to Vol. 47 (Pts. 1 and 2). With only one coloured and 28 black-and-white plates the total cost that year came to Rs. 12,755-8-4.

Since then the cost of paper as well as of printing have risen still higher. At the present time the 3 numbers of the *Journal* which we normally publish during a year, containing the average number of black-and-white plates and an occasional coloured one, cost us roughly Rs. 15,000.

For the grousy ones who insist on knowing why we don't provide a larger number of plates, and for the magnanimous ones, like Mr. W. T. Loke and Dr. Dillon Ripley in the present issue, who like to make gifts of coloured plates to the *Journal* now and again, it might be mentioned that apart from the original painting or colour transparency, each colour plate costs us on an average Rs. 360 and each black-and-white plate Rs. 120.

There is no more befitting manner in which readers can express their appreciation of the *Journal* than by donating plates to it, and it is a form of appreciation which the editors would like zealously to encourage.

But plates alone are not enough. We want the co-operation of all naturalists and observant sportsmen in sending us notes about any interesting or unusual natural history incident or fact that may have caught their attention, and we want all serious field workers to send us the results of any original investigations they may undertake. The opportunities in India for field study of every description are limitless. Past journals are replete with examples of the type of material we need, and it is only with the active co-operation of members that we can make our journal something that they will look forward to three times a year and wish for a fourth.

PROPOSED RE-CHRISTENING OF THE *Journal*

From time to time there has come a suggestion from several active members, some of them eminent scientific men, that a shorter title should be found for our journal to eliminate the labour or repeating the lengthy 'Journal of the Bombay Natural History Society', even when abbreviated to 'Jour. Bom. Nat. Hist. Soc.' or merely to 'J.B.N.H.S.' in references and bibliography. There is much to be said for this plea, and only workers who have the need to quote this journal frequently in their writings are able fully to appreciate its force and relevancy.

It has been suggested that for the sake of brevity and convenience the *Journal* be christened 'Hornbill' or one of its Indian equivalents, say 'Garuda'. Its full title would then read 'Garuda—The Journal of the Bombay Natural History Society', but for purposes of reference or quotation, simply 'Garuda' would be explicit. There are a number of well-known precedents for this kind of title, some of which were adopted after the publication had been running under the longer name for some years, e.g. *The Auk* which was up to a certain date known as 'The Journal of the American Ornithologists' Union'. Other scientific periodicals with abbreviated titles of the same sort are *The Ibis* which is the official organ of the British Ornithologists' Union and

Oryx: 'The Journal of the Fauna Preservation Society'; and there are many besides in other parts of the world.

It has been argued by some that the adoption of the name Hornbill or Garuda would convey the misleading impression that ours was a purely ornithological journal and not one of general natural history. For many years now the Great Indian Hornbill within a circle has been the recognised crest of the Society and as such everybody is familiar with it on the top cover of the *Journal* and on the title page of almost all the Society's recent publications. It would seem that the mere addition of the word Hornbill or Garuda on the cover is hardly likely to cause the misconception.

The proposition was discussed at a recent meeting of the Society's Executive Committee and it was thought desirable to invite members' views. If members have any objection to the proposal, except on purely sentimental grounds, will they please communicate them to the Honorary Secretary?

It is true that there are other publications as for instance 'Transactions of the Entomological Society', 'Proceedings of the Zoological Society, London' and 'Journal of the Asiatic Society of Bengal' who have not felt it necessary to abbreviate their titles in the way here proposed. But the question here is not whether we can also get along as they do, and as we have in fact so far done, but whether the change would not be a very definite advantage from the practical point of view. If consensus of competent opinion favours the change, no time will be more opportune for making a beginning than from the December issue of the *Journal* which will mark the commencement of volume 51.

DEEP-SEA OCEANOGRAPHIC EXPLORATION IN INDIAN WATERS

BY

LIEUT.-COL. R. B. SEYMOUR SEWELL, C.I.E., SC.D., F.R.S.

(*With three plates*)

The science of Oceanography is of relatively very recent origin, and is of such a wide nature that it necessitates the study of many other branches of science. It includes not only the chemistry and physics of the sea-water and a study of the meteorological conditions of the atmosphere but also a detailed study of both botany and zoology, since the oceans are inhabited by both plants and animals, and the distribution of the flora and fauna necessitates a study of the physiology and the manner in which animals and plants are adapted to the particular conditions in which they live and the degree to which such differences in the environment can influence the growth and development of the animal or plant. These conditions show a very wide range of variation both horizontally as one passes from the warm tropical area to the cold Arctic and Antarctic regions, and vertically as one passes from the surface of the sea down to the great depths. The study of the ocean floor and of the sedimentary deposits that cover so much of its surface calls for the application of seismology, geology and petrology, while the changes that are continually going on in these bottom deposits require a knowledge of organic chemistry and bacteriology.

Only a hundred years ago scientists were of the opinion that living organisms could not possibly exist in the very peculiar conditions that are present in the great depths of the ocean, such as the complete absence of sunlight, the cold temperature and the enormous pressure that may amount to several tons to the square inch in the deepest layer; it was thought that a depth of about 400 fathoms was the lowest level at which life could exist, but within a few years this view was to be proved wrong.

During the nineteenth century it had become recognised that very valuable contributions to our knowledge could be achieved by providing a scientist to accompany any expedition, and that the experience so gained would be of great value to whoever was selected. By the middle of the century several British scientists had achieved world-wide reputations as a result of their work on such expeditions. I need only mention the names of Charles Darwin, who sailed round the world in the 'Beagle' in 1831-36; Joseph Hooker, who accompanied Sir James Clark Ross to the Antarctic in the 'Erebus' and 'Terror' in 1839-43; and T. H. Huxley, who sailed as Assistant-Surgeon in the 'Rattlesnake' to Australia and the Great Barrier Reef in 1846-50. The development of inter-continental communication that took place as a result of the invention of the telegraph, and the necessity of a careful survey of the lines along which submarine cables could safely be laid, resulted in several cable-ships being sent out to study the contours of the sea-bed and select suitable routes. One of the vessels engaged in this work was the 'Bulldog' under the command of Captain M'Clintock, which was engaged in surveying a line for the trans-Atlantic cable between England and North America in 1860. Accompanying this expedition was Surgeon-Major G. C. Wallich, who had retired from the Indian Medical Service and who was the son of Nathaniel Wallich who had been the Superintendent of the Sibpur Botanical Gardens. Wallich showed beyond any doubt that animals could live at depths below 1,000 fathoms; and in consequence of his discoveries British zoologists persuaded the Admiralty to send out an expedition to investigate the Atlantic deep water round the British Isles and in the Bay of Biscay, at first in the 'Lightning' in 1868 and in the 'Porcupine' in 1870. The success of this work led to the famous voyage of the 'Challenger', which carried out during the years 1872-76 investigations in all the great oceans on the fauna and flora, the character of the sea-water at all depths and a study of the bottom and its sedimentary carpet, thus laying the foundations for the science of Oceanography.

During the years 1832-62 a survey of Indian waters had been conducted by the Indian Navy: but this service was abolished in the latter year. From time to time ships of the Indian Navy had carried medical officers, who were interested in biology and took the opportunity to carry out valuable research work. Two of these officers became distinguished, namely Dr. H. J. Carter, F.R.S., and Dr. Theodore Cantor, the former becoming one of the leading authorities on the lower invertebrata, especially the Porifera, and the latter on the fishes of the Malay Peninsula.

With the abolition of the Indian Navy, the Marine Survey temporarily ceased; but in 1872 the Government of India inaugurated the Marine Survey of India and the very important work being done at this time by the 'Challenger' caused the Asiatic Society of Bengal to urge the Government of India to include in the ship's company the appointment of a Surgeon-Naturalist whose duty it would be to carry out, when opportunity offered, in Indian waters not included in the 'Challenger' programme, similar investigations into the fauna of the deep sea and also the conditions that existed at different depths and the character of the sea bottom. This proposal was warmly supported by Commander Dundas Taylor, who was appointed to command the Marine Survey. The Government of India agreed to this proposal and in 1875 the post of Surgeon-Naturalist was created and Surgeon J. Armstrong was appointed. He was the first of a succession of Indian Medical Service officers, who during the next 51 years either temporarily, or in three cases permanently, devoted their attention to the study of zoology and so, if I may adopt the charming phrase by which Phillip Gosse in his autobiography summed up his own life's work, became 'A Truant from Medicine'. Armstrong continued to hold the appointment till 1879, but as no suitable vessel was then available he could only carry out observations in shallow water and in the littoral region, at first in S. S. 'Clyde' and later with a boat-party. He relinquished the appointment in 1879 and the post remained vacant till 1884. The honour of being the first to carry out deep-sea biological work in Indian waters fell, not to the Surgeon-Naturalist, but to an officer of the Indian Museum, Calcutta, Dr. J. Wood-Mason, who was sent in 1871 by the Trustees of the Museum to investigate the fauna of the Andaman Islands. During the four months that he spent in these islands he managed to persuade the Governor to allow the Guard-Ship, S.S. 'Undaunted' to work for him for one day and so was able to carry out trawls in depths of 100 to 300 fathoms.

The first of the Indian Marine Survey ships was built in 1879-80. She was a wooden paddle-steamer of 580 tons and was launched in 1881, being given the name 'Investigator', thus continuing a tradition that existed in the British Empire, for in 1850 a vessel of this name was one of the ships sent out to try and discover what had happened to Sir John Franklin and his crew, who had sailed from England in 1846 to try and discover a north-west passage between the Atlantic and Pacific oceans. There had also been among the ships of the Bombay Marine a previous 'Investigator' which had carried out hydrographic investigations as a secondary part of her duties. In 1878 Lieut. Jarrard, R.N., who had been appointed to the Marine Survey of India under Commander Dundas Taylor, was in England on leave; the 'Challenger' had recently returned from her world-cruise and Jarrard took the opportunity of consulting the scientists who had sailed in her regarding the apparatus necessary for deep-sea investigations. He then went to the Admiralty and requested their assistance and the Government of India also asked for some of the 'Challenger' apparatus to be presented to the 'Investigator'. The Admiralty was willing to do so, and so it came about that when the Marine Survey of India commenced deep-sea work in Indian waters they were actually using 'Challenger' gear. The post of Surgeon-Naturalist remained vacant till 1884, but in that year Commander Alfred Carpenter, R.N., who had been one of the officers in the 'Challenger', was appointed to command the Marine Survey and Surgeon G. M. J. Giles was appointed Surgeon-Naturalist, and deep-sea research became one of the duties, if only a secondary one of the Survey.

It may be of some interest to my readers if I give here a brief account of the position that the Surgeon-Naturalist occupied on board the survey vessel at any rate as it was in my day. The Surgeon-Naturalist, when first appointed, was usually a relatively junior officer, either a Lieutenant or Junior Captain; he was the Senior Medical Officer of the ship and so was directly responsible to the Captain for the sanitary condition of the ship and for the health of the officers, and indirectly for the health of the crew, which numbered about 110. To the Surgeon-Naturalist was attached an Assistant-Surgeon, who was directly responsible for the crew, the Surgeon-Naturalist merely keeping a watchful eye on his work and only intervening when a lascar had been on the sick-list for more than three days. As the ship's crew were specially selected at the commencement of each survey-season and the vessel was at sea on the survey-ground for some twenty-seven or twenty-eight days in each month, only returning to port in order to re-victual and re-coal for about three days, there was very little sickness on board, and surgical work was almost non-existent unless there was an accident in the engine-room or an emergency, such as a dislocated limb or a fracture. There was thus plenty of time for biological and other scientific investigations. As he was the only 'land-lubber' among a group of professional sailors, the attitude of his colleagues to him would to some extent depend on whether or not he proved to be a good sailor and could stand up to a certain amount of rough weather, and also was a 'good mixer' and could take a certain amount of good-natured 'leg-pulling' by his ship-mates: for instance, on Sunday mornings the Officer-Commanding occupied the Ward-Room for the purpose of carrying out a function known as 'Signing all Books', a business with which the Surgeon-Naturalist had no concern. One Sunday morning I was on deck chatting to some of my brother officers, when a lascar came up from below, saluted, and said to me, 'The Captain wishes to see you, Sir'; so I put on my jacket and cap and went down to the Ward-Room. I saluted and said, 'You wish to see me, Sir?'; 'Yes, I certainly do', said he with a grim expression on his face. 'How long have you been in this ship?' 'About ten years, Sir', said I, wondering what the trouble could be and whether my Assistant-Surgeon had failed to carry out his duties properly and I had failed to discover his error. 'Ten years! *Ten* years!! and you don't know better than this.' Clearly, whatever had gone wrong I was going to be held responsible. 'What's the trouble, Sir?' I asked. 'What's the trouble?', he replied, 'What's the trouble? Here we are, the 15th of the month and your wine-bill is only Rs. 5'. 'Well, Sir, that's easily remedied. What's yours?' 'Thanks very much, I'll have a cocktail'!

In the early years of the Survey the areas that most urgently needed investigation around the coasts of India and Burma were relatively small and scattered, and several of these might be visited and surveyed each year. It thus happened that the 'Investigator' might traverse the Bay of Bengal several times in a single season and it was during such runs that deep-sea trawls could be carried out. The publication of Charles Darwin's great work on 'The Origin of Species' in 1859 had thrown a new light on the study of zoology, and the work of the 'Challenger' had proved conclusively that animals were to be found living at almost all depths between the surface and the sea-floor; it had been hoped that the investigation of the fauna of the great oceans might reveal a number of 'missing links' in the evolution of the species of the present day. Though the hope was not realised, it was but natural that the Surgeon-Naturalist should take more interest in and concentrate his energies on a study of the deep-sea fauna rather than on the physico-chemical character of the sea-water or the nature of the sea-floor.

In the year 1888 A. Alcock was appointed to be Surgeon-Naturalist and he held the post till 1892. In the accompanying Table I give the number of trawls that were carried out by the 'Investigator' in each 5-year period from the commencement of the work in 1885 till it came to an end in 1926. A reference to this shows that a great increase in the number took place during his tenure of the office, and some idea of the mass of material that was collected during these early years can be got from 'A Summary of the Deep-Sea Work of the Royal Indian Marine Survey Ship "Investigator" from 1884 to

R.I.M.S. ' INVESTIGATOR I '

The name ' Investigator ' carved on the facade of the Oceanographic Institute at Monaco

R.I.M.S. 'INVESTIGATOR II'

H.E.M.S. 'MABAHISS'

Arriving back at Alexandria, May 25, 1934

1897' published by Alcock in the series of 'Scientific Memoirs by Medical Officers of the Army of India' in 1898.

TABLE SHOWING THE NUMBER OF TRAWLS OF DIFFERENT KINDS MADE DURING EACH 5-YEAR PERIOD BETWEEN 1885 AND 1925

Year	Agassiz trawls		Mid-water trawls
	Deep	Shallow	
1885–1889	21	43	...
1890–1894	52	55	...
1895–1899	55	21	...
1900–1904	76	13	...
1905–1909	30	4	...
1910–1914	10	25	4
1921–1925	3	1	3

I give below a list of the numbers of the various species and genera that were obtained during this period from depths below 100 fathoms.

——	New species and varieties	Previously known species	Number of genera
Protozoa	8	...	...
Porifera	26	5	11
Madreporaria	17	8	14
Cnidaria	...	...	...
Asteroidea	39	15	26
Ophiuroidea	38	17	23
Echinoidea	6	2	6
Holothuroidea	6	11	12
Crustacea:			
Cirripedia	2	...	2
Amphipoda	3	...	3
Isopoda	...	2	2
Stomatopoda	2	...	1
Schizopoda	2	8	5
Macrura	54	43	45
Anomura	35	5	6
Brachyura:			
Cancroidea	5	...	5
Ocypodoidea	2	...	2
Oxystoma	13	...	9
Oxyrrhyncha	10	4	8
Pycnogonida	...	2	1
Mollusca:			
Lamellibranchiata	31	8	23
Gastropoda	31	7	24
Scaphopoda	5	1	1
Cephalopoda	6	4	8
Pisces:			
Chondropterygii	5	1	5
Acanthopterygii	23	15	30
Anacanthini	48	8	24
Physostomi	41	16	39
Plectognathi	1	...	1
Grand Total	459	182	336

In spite of the enormous advances that had already been made by the 'Challenger', no less than 71 out of every hundred species or varieties recorded from Indian waters proved to be new. These zoological results were embodied in a magnificent series of 'Investigator' Memoirs, that were published by the Trustees of the Indian Museum, namely:—

Echinoderma, pts. 1-8	1889-1914
Squillidae	1895
Brachyura	1899
Fishes	1899
Decapoda, Macrura and Anomala ...	1901
Crustacea, pts. 1-3	1901-1906
Hexactinellid Sponges	1902

Accompanying these Memoirs a series of plates was published by the Royal Indian Marine under the title of 'Illustrations of the Zoology of the Royal Indian Marine Surveying Steamer "Investigator" between 1892 and 1909'. In addition to the faunistic work of the Surgeon-Naturalist, other observations were made on the temperature of the sea-water at both the surface and near the bottom and a number of samples of the bottom deposits were taken and reports dealing with 'The Mean Temperature of the Deep Waters of the Bay of Bengal' and the 'Topography of the Arabian Sea in the Neighbourhood of the Laccadive Islands' were published in the *Journal of the Asiatic Society of Bengal* by two of the officers commanding the Marine Survey, namely Captain A. Carpenter in Vol. LVI in 1887, and Captain Oldham in Vol. LXIV in 1895. But the observations on the bottom deposits were not published till many years later, when I was able to collate them and get them published.

By the beginning of this century the zoological work of the Marine Survey of India had attracted world-wide attention, and the great importance of these contributions to our knowledge of marine life had earned for the 'Investigator' the honour of having her name carved on the facade of the new Institute of Oceanography in Monaco that was erected by H. R. H. Prince Albert I. I am greatly indebted to Captain Rouch for having this photograph specially taken for me. Other well-known ships similarly honoured were the 'Challenger', 'Travailleur', 'Talisman', 'Gazelle', 'Novara', etc. These investigations had also built up for succeeding Surgeon-Naturalists such a high reputation that in 1913, although I was but a junior officer of the Indian Medical Service and had held the appointment for only two-and-a-half years, I was appointed a Vice-President of Section V, Oceanography, at the meeting of the International Congress of Zoology that was held at Monaco that year.

From 1904 on, the number of trawls that were carried out shows a somewhat rapid decline. The amount of deep-sea work that the Surgeon-Naturalist could get done depended on the situation of the survey ground, and as the whole of the survey season was now spent, as a rule, in one particular region the only time that the ship was in deep water was during her passage to and from her home port of Bombay at the commencement and conclusion of the season's work:

thus the time that could be devoted to trawling became less and less. Another very important factor was the interest, or lack of it, shown by the Officer Commanding. By this time the novelty had worn off and so one had to use to the utmost one's powers of persuasion, and if this failed other steps had to be taken. There is a story of one of my predecessors that illustrates this: the Surgeon-Naturalist naturally wanted to get as many trawls carried out as he could, but the O.C. wasn't interested: however, he hated to see any of his officers with no work to do, so the Surgeon-Naturalist devised a scheme which consisted of getting a comfortable deck-chair, which he placed on deck where he could be seen from the bridge, and settled himself there with a bottle of beer and the latest novel from the ship's library. Every time that the O.C. looked forward over the bridge-rail he couldn't help seeing this officer, and eventually this got too much for his feelings and he called down 'Got no work to do?' 'No, Sir; I am afraid not,' replied the Surgeon-Naturalist. 'Ha! Can't have this, we'll have a trawl'!!

In 1908 the old 'Investigator I' was scrapped and 'Investigator II' took her place. The new vessel was a steel ship built by Vickers Maxim and Co., of a gross tonnage of 1,018 tons and capable of steaming at about 14 knots. Owing to the decline in the amount of deep-sea work the Surgeon-Naturalist was able to commence work in other branches of oceanographic research and so when I was appointed in 1910 I took up the study of the Copepoda which form an important constituent of the floating population of the sea, termed the Plankton, and of the conditions of salinity and temperature of the sea-water in which these animals live. I also collated all the previous observations that had been made on the topography and nature of the sea-floor. The results thus obtained have been published in the *Memoirs of the Asiatic Society of Bengal,* Vol. IX, between the years 1925-35.

While on the survey-ground the 'Investigator' anchored each night in the week, and from mid-day Saturday to Monday morning in some more or less sheltered locality. In order to obtain samples of the surface plankton one or more tow-nets were put out at 6.00 p.m. and the tide was allowed to drift through them till 6.00 a.m., when they were hauled in and the catch was taken down to the laboratory for examination and preservation. Samples of the surface-water and a record of its temperature were taken, usually at four-hourly intervals throughout the day at 4, 8 and 12 a.m. and p.m.: certain meteorological observations, such as the air-temperature readings by both wet- and dry-bulb thermometers, the barometric pressure and the strength and direction of the wind were also made. The water samples were examined as soon as possible after they had been collected. All this, involving both day and night work was, as must be obvious, considerably more than one individual could accomplish; but I was greatly assisted by the ship's staff, both officers and men, and to them I owe a deep debt of gratitude. There were occasions when some fluid other than sea-water was substituted for the sample that had been taken during the night, but examination at once revealed the substitution, and on a protest being made the true sample was usually forthcoming. When all these observations were correlated and compared with the total quantity of the plankton or with the number of any particular organism, such as the common Salp, *Salpa* (*Thalia*) *democratica* (Forskal), some very interesting results were obtained. It was found that the salinity of the surface water exhibited a double diurnal variation that at one period of the year coincided and at another alternated with the rise and fall of barometric pressure. The conclusion to be drawn seems to be that with the change of barometric pressure there is a corresponding change in the strength of the wind, and that an increase in the wind-force brings about a corresponding increase in the lateral movement of the surface water that is compensated for by an upwelling of water from some depth below the surface, this deeper water having a lower salinity than the surface water during the hot dry period of the year in consequence of evaporation and a higher salinity during the wet, cold period owing to the dilution of the surface water by rainfall and the increased influx of river water into the neighbouring area. The salinity of the surface water also showed oscillations of a longer period, from a few days to as long as a fortnight, in different localities, and these oscillations appear to correspond, as regards their period, to the estimated time of a 'seiche', i.e., to a to-and-fro swing of the deep water in the basin in which the locality is situated, as for instance in the Andaman Sea. During the monsoon periods the wind, blowing in a particular direction, causes a piling up of the surface water on one side of the basin and a corresponding depression of the level of the deep water, and when the wind ceases the two strata of water, upper and lower, begin to re-adjust themselves so that the boundary in between shall once again be horizontal. In this process the level of the deep water swings up and down on the two sides of the basin, rising at periodic intervals nearer to the surface where admixture with the surface layer can be brought about by wave action: accompanying this periodic rise and fall in the salinity there may occur a marked rise and fall in the number of some of the planktonic organisms in the surface water. After a year's experience of purely surface work I was desirous of extending these observations to the mid-water regions. I therefore requested the authorities of the Royal Indian Marine to sanction the construction in the dockyard of nets suitable for mid-water trawling. At first my request met with some degree of opposition and I was asked what put this new idea into my head, and why I should suppose that the Marine Survey should undertake it; but when I pointed out that it was no new idea, since observations of this type had been carried out by the 'Challenger', and that it did not exactly reflect credit on the Marine Survey that they had for so many years entirely neglected this important branch of oceanographic research, consent was given and a 6-foot square mid-water trawl was constructed. Four hauls of this net, taken in the survey-season 1911-12 at depths of from 375 to 475 fathoms yielded some very interesting catches and very greatly increased the number of Copepoda that were known to inhabit Indian waters.

The outbreak of the First World War in 1914, brought the work of the Marine Survey to an end for the time being, and it was not till 1921 that I was able to resume my marine investigations. During the next four years the 'Investigator' was engaged in surveying in the Maldive Archipelago and in the central group of the Nicobar Islands, regions in which there is a profuse growth of coral, and I was thus able to study the probable mode of formation and the present conditions existing in such localities; but there was little opportunity for continuing deep-sea work.

On my relinquishing the appointment of Surgeon-Naturalist in 1925 Major R. W. G. Hingston was appointed; but he only held the post for one year after which he resigned from the Indian Medical Service, and the post again became vacant. The Director-General of the Indian Medical Service notified the Government of India that there was no officer serving under him who appeared to have the necessary qualifications, and he recommended that the post should be abolished. In my capacity of Director of the Zoological Survey of India I strongly opposed this and urged the Government of India not to abolish the post altogether but to change its character and substitute for the Surgeon-Naturalist the post of Naturalist to the Marine Survey and attach it to the Zoological Survey of India. This the Government of India agreed to do, but although this post continues to exist in theory, in practice no appointment has ever been made. Thus in 1926 the work of the Surgeon-Naturalist came to an end.

The scope and the methods employed in the study of oceanography have rapidly expanded during the last half century. New discoveries in other sciences (and especially in physics) have been adapted for oceanographic work and have resulted in a very considerable advance in our knowledge of the oceans: one of the first of such inventions was the development of 'Asdic' during the 1914-18 war. This method made use of an echo for the detection of enemy submarines; but later it was adapted to give the depth of water below a vessel, and a ship fitted with the apparatus was able to take soundings at the rate of about 25 to the minute, while steaming on her course whereas previously, by the lead and sounding-wire method, a single deep sounding used to take two hours or more, during which time the ship was stopped and was manoeuvred to keep the wire straight 'up and down'. While greatly increasing our detailed knowledge of the features of the ocean bottom, this method has one great disadvantage, it does not give one a sample of the bottom deposit. More recently another method for the study of the ocean bed has been borrowed from the science of seismology and by exploding a small charge either on the sea-bed or in the water above it and by getting accurate records of the time taken for the resulting vibrations to pass down into the sea-bed and be reflected back to the recorder on the vessel, an estimate can be made of the depth at which different strata lie below the carpet of bottom sediment and of the thickness of these strata.

From time to time research vessels have passed across the southern region of our Indian waters either on their way to or return from other parts of the world. In 1899 the German Deep-Sea Expedition in the 'Valdivia' on her return voyage crossed from the northern point of Sumatra to Colombo and on to Dar-es-Salam in Africa and then turned up the African coast to the Gulf of Aden and the Red

Sea; in 1928-30 the Danish Carlsberg Expedition in the 'Dana' during her world-cruise followed much the same course but on reaching the African coast turned southwards to pass round the Cape of Good Hope. The 'Dana' was equipped with echo-sounding apparatus, and during her passage across the southern part of the Arabian Sea obtained evidence of a great submarine mountain range rising from the bottom of the ocean. The late Prof. Johannes Schmidt, the Leader of the Expedition, from a study of these and previous soundings, concluded that a great submarine range extends roughly from the island of Socotra off Cape Guarda-fui to the Chagos Archipelago, and for this ridge he suggested the name Carlsberg Ridge. In a paper that I submitted to the Asiatic Society of Bengal for publication in April, 1933, I had put forward the view that such soundings as were then available seemed to indicate that a submarine ridge ran in a south-westerly direction from the Indian coast in the neighbourhood of Karachi towards Socotra and I suggested that this might be a submerged continuation of the Kirthar Range of Sind that had been involved in the formation of the great 'fault' that had, at about the close of the Tertiary epoch, given India its present western coast-line.

The next stage in the exploration of the northern region of the Indian Ocean came in 1933 when the 'John Murray' Expedition to the Indian Ocean was fitted out and sailed from Alexandria in the Egyptian research vessel, H.E.M.S. 'Mabahiss'. The primary object of this expedition was to investigate the fauna of the deep water below 100 fathoms and the nature of its habitat, and the region to be studied was the area to the west of the Laccadive and Maldive Archipelagoes, so as to continue the previous investigations of the 'Investigator' westward to the African coast. For the most part these earlier investigations had been confined to the Laccadive Sea, the Bay of Bengal and the Andaman Sea, though in 1895-96 she had carried out a survey of the Indian coast off Karachi and in the region of the submarine gulley of the 'Indus Swatch'. She had also worked in 1901-02 in the Gulf of Oman and the Persian Gulf, and in 1904-05 along the Arabian coast and in the Gulf of Aden. Evidence of the richness of the fauna in this area was obtained at 'Investigator' Station 364 off the south coast of Arabia, in a depth of 110 fathoms, where over 500 examples of a species of 'Mantis Shrimp' were taken in the trawl. The story is told that the Surgeon-Naturalist, in view of the large number taken, concluded that the species must be a common one, though he couldn't remember having seen it before. He therefore preserved about 20 specimens and handed the remaining 480 over to the Mess cook, who made an excellent 'Prawn Curry' out of them, a change from ship-borne mutton that was greatly appreciated. On his return to the Indian Museum at the end of the survey-season, the Surgeon-Naturalist made a careful examination of his 20 specimens and then discovered that these represented a new species, which he christened *Squilla investigatoris*. It was thought that most of the big zoological museums all the world over would have been willing to give £1 for a co-type of this new species, so that this 'prawn curry' was one of the most expensive dishes ever served on board! No further examples of this species were taken till the 'Mabahiss' carried out a series of observations in the same

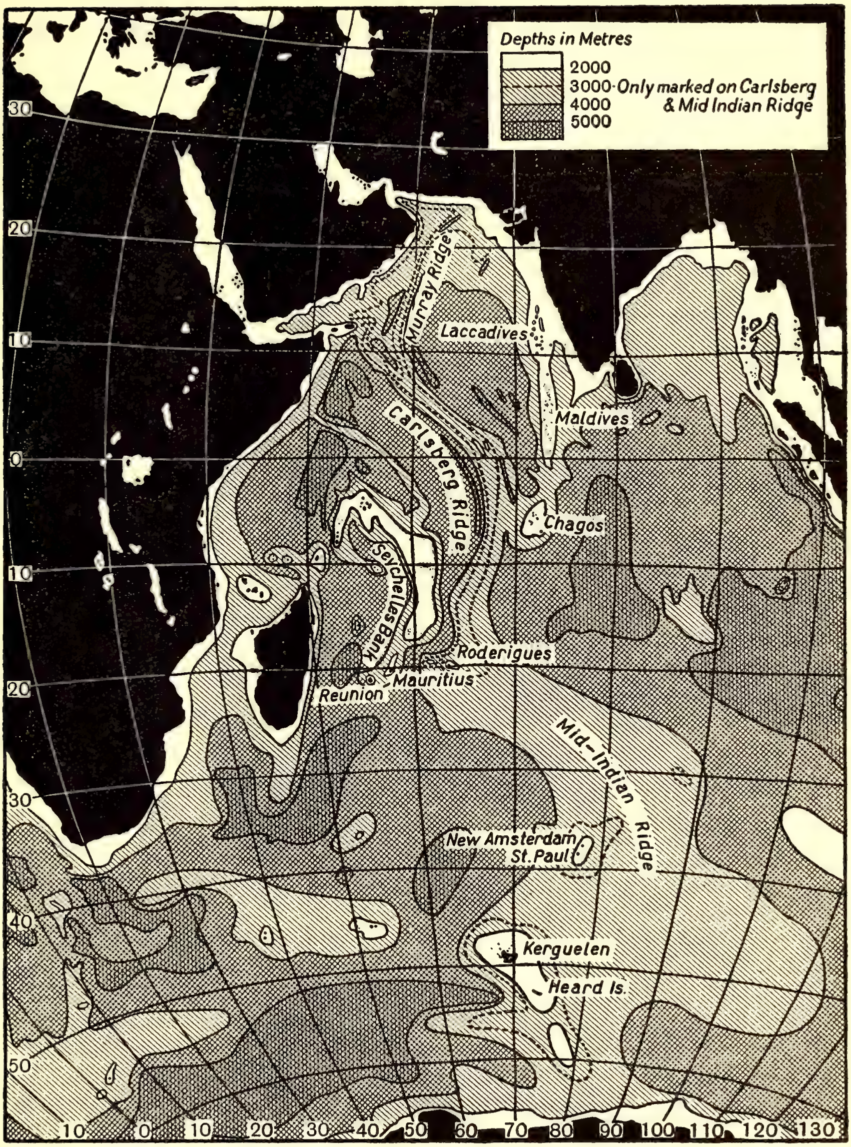


CHART OF THE ARABIAN SEA

(Reproduced with permission from *The Geological Magazine*, 1937)

region, but the extraordinary concentration of the species in this locality is shown by as many as 14 examples being taken in one-half a square metre of the sea-floor by a haul of the grab.

The topographical results obtained by the 'Mabahiss' are shown in the chart. (Plate III.) From this it is seen that the existence of both the above-mentioned submarine mountain ranges was confirmed, and we were fortunate enough to obtain actual specimens of the rocks of which the Carlsberg Ridge is composed. This ridge near the Equator in long. 66° 34′ E. is composed of basalt while further to the northwest in lat. 7° 14′ N. × long. 60° 38′ E. fragments of a rock resembling consolidated Globigerina ooze were obtained. The presence of basalt is particularly interesting in view of the opinion of most, if not all, geologists that a large area of the Deccan Trap, which covers so much of India, must have been broken off and has sunk to the bottom of the Arabian Sea. But the chemical composition and the radio-activity of this submarine basalt is markedly different from that of the Deccan Trap and so cannot be regarded as an outlying part of it. The general results are particularly interesting for they prove quite clearly that the character of the sea-bed is far more irregular than was previously thought to be the case, and that there is an enormous submarine mountain chain that runs from north to south through the whole of the Indian Ocean and finally connects with the Antarctic continent.

Although the work of reporting on the 'John Murray' collections is far from complete, an analysis of those reports that have been published shows that of the fauna of this region out of the 1,642 species so far identified, 240 new species or varieties have been discovered—a proportion of about 14.6 per cent.

All along the Arabian south coast and in the Gulf of Oman we encountered a most interesting difference at different depths in the character of the fauna. From the entrance to the Gulf of Aden and stretching eastward is a zone that at its eastern end, near Cape Ras-al-Had, extends downwards from a depth of some 200 m. to about 1,250 m. in which there is little or no life, whereas above and below this zone the fauna is extremely rich both in species and in numbers. Towards the west, in long. 46° to 51° E. living at or near the edge of the continental shelf in about 200 m. depth there is a large population, consisting of 225 examples of certain lobster-like crustacea, such as *Puerulus sewelli* Ramadan and *Scyllarus orientalis* Spence Bate, and huge numbers of certain echinoids, such as *Clypeaster annandalei* Koehler, between 4,000 and 5,000 examples of this latter species having been taken in a single haul. A little further east, between long. 48° and 52° E., at about the same depth, we have the haunt of the stomatopod, *Squilla investigatoris* Lloyd, to which I have already referred; at the head of the Gulf of Oman, in lat. 25° 10′ N. × long. 56° 47′ E., at 210 m. depth the commonest inhabitant was a species of holothurian, probably a *Stichopus*, as many as 666 examples being taken in one haul. At the head of the Gulf of Oman, between long. 56° and 57° E., the most frequent ingredient of the fauna at about 200 m. depth is the mollusc *Rostellaria delicatula* Nevill and the empty shells of this species occur with great frequency in the mud of the azoic area at deeper depths. This deposit is of considerable interest to geologists because of its close resemblance to a deposit that Blanford discovered at Barrah in Sind. Here he recorded the presence of 'a bed abounding in a species of *Rostellaria*, apparently the *R. columbaria* of D'Archiac and Haine, but a very different form from the true *R. columbaria* of Lamarck': the age of this bed appears to be Middle Eocene and further north near Attock similar beds of the same period have been found to be petroliferous, and it has been suggested that we have here in the Gulf of Oman and along the Arabian coast an area where petroleum is in process of formation. In the deep water at depths of some 2,000 to 2,500 m. below the level of the azoic area, in about long. 50° E., the most conspicuous ingredient of the fauna are large ophiuroids, especially *Ophiura irrorata* (Lyman) and *Ophiomusa lymani* (Wyville-Thomson), as many as 206 examples of this last species being taken at Station 135, while further east, in long. 59° 50′ E., at a depth of 950 m. thousands of ophiuroids, belonging to several species, were taken in one haul. Throughout the azoic area the bottom deposit consisted of a greenish mud that in some areas contains a high percentage of sulphuretted hydrogen gas, while the supernatant water is almost entirely devoid of oxygen. These conditions are almost certainly attributable to the putrefaction of organic matter, of which the mud contains a relatively high percentage—between 4 and 5 per cent in contrast to about 1 to 1.5 per cent over most of the bottom further south. The origin of this high percentage of organic matter in the bottom deposit is to be found in the amazingly rich zoo-plankton that is present, along the African and Arabian coasts and extending eastward towards India, during the months of the Southwest Monsoon and shortly after. The cause of this rich plankton is to be found in the upwelling of deep water all along the coasts of East Africa and Arabia under the influence of the Southwest Monsoon wind. This upwelling water is rich in nutrient salts, nitrates and phosphates, and thus provides the necessary conditions for a rich outburst of phyto-plankton that is followed by an amazingly rich zoo-plankton; and as the dead bodies of these organisms sink to the bottom and accumulate in the mud, they provide nutriment for large numbers of other animals in the zones above and below the azoic region where there is sufficient oxygen to support life.

Before closing this summary of the oceanographic work that has been carried out in the Indian region, mention must be made of the work that has been done in the study of the depth of water and the hydrographical conditions that exist. A number of vessels of the Royal Navy have made observations of great value to students of marine life, and among these I may mention H.M.S. 'Sealark' (1906) which carried the Percy Sladen Trust Expedition to the Indian Ocean under the leadership of the late Prof. J. Stanley Gardiner, F.R.S. Other vessels are 'Penguin' (1891), 'Stork' (1897), 'Merlin' (1920), 'Ormonde' (1927), 'Endeavour' (1933), 'Challenger' (1946), 'Owen' and 'Delhi' (1950).

Many other collections and observations have been made of the fauna of the Indian coastal and shallow water regions. From time to time the Surgeon-Naturalist was able to leave the 'Investigator' for a short time, usually a week or so, and camp on the sea-shore in the neighbourhood of the Tide-watching Party; and was thus able to make extensive collections of the littoral fauna. From time to time members of the Zoological Survey of India have visited and collected in various parts of the long Indian coast-line and much has been added to our knowledge by the work of the research vessels employed by the Fishery Departments of Madras, Bengal and Bombay. In addition the officers of the Madras Museum and the Marine Biological Department of Madras University have studied the fauna of Krusadai Island, the officers of the Bombay Natural History Society have carried out a survey of the fishes of the Bombay coast, and other private individuals have made extensive collections. Among these last mention may be made of James Hornell, who carried out a survey of the Okhamandal coast, of A. J. Abercrombie, who collected intensively round Bombay and, in collaboration with J. C. Melvill, enumerated 320 species of molluscs. W. F. Townsend, who collected round Karachi and in the Persian Gulf between 1893 and 1900, recorded as many as 935 species of Mollusca from the region of the Persian Gulf, the Gulf of Oman and the northern part of the Arabian Sea and also made collections of the fishes of this area. A full consideration of the littoral and shallow water work is, however, beyond the scope of this review.

THE CLIMATE OF INDIA

BY

S. K. BANERJI, O.B.E., D.SC., F.N.I., F.R.M.S., F.A.SC.

(*With five plates, one text figure and a graph*)

CLIMATIC VARIATIONS

Post glacial time falls into three main stages: first, a period of steadily increasing warmth, covering the establishment and decline of northern coniferous flora; next a long period of maximum warmth, marked by the dominance of deciduous forests; and finally an indication of decreasing warmth accompanied by gain of conifers at the expense of deciduous species. These results came from pollen analysis. There are minor variations, namely, return to warm conditions a thousand years ago and a present trend to warmer and drier conditions, which may be no more than a passing phase. In producing these long-period changes some common cause was at work, which has also been changing more or less rhythmically. There has been much discussion over this common cause, but at present attention is centred mainly on the variations of the seasonal distribution of insolation in different latitudes through changes in the constants of the earth's orbit, the inclination of the earth's axis and the long-period changes in the solar radiation.

People are never able to count on the weather. Directly or indirectly it is the ruling variable in all of man's enterprises. It makes farming, the occupation of 65 per cent of the world's population, the most critically speculative enterprise of all. Through the ages, the Indian farmer has ever prayed to the 'rain-gods' to shower timely and plentiful rains for his crops. The weather is intrinsically neither good nor bad. In its extreme violence, men and their material wealth are destroyed. Human life is itself an equally incidental of 16,000,000 tons of rain and snow that fall upon the earth's surface every second.

India presents as great contrasts in meteorological conditions as any area of similar size in the world, and furnishes the typical large-scale example of the alternation of seasons known as monsoons. The contrasts are striking.

In the northwest lies the great Thar desert with an average annual rainfall of less than 5 inches; in the northeast is Cherrapunji with an average annual rainfall of 424 inches. The observatory at Dras in Kashmir has recorded a temperature as low as –49°F. in the winter months; while in the summer months temperature as high as 120° and over is not infrequent in the desert of Northwest India. Hill stations in the Himalayas, such as Simla, may be shrouded in cloud for days together in August and September with humidities of 100 per cent., but in December may be overrun with air of very nearly zero humidity.

The mean annual range of temperature at Cochin in South India, 20°F., is less than the daily range at many stations in North India and only about one-third of their annual range. During the winter third of the year the general flow of the surface air strata is from land to sea and thence over the Indian seas as a north-east monsoon (Plate I); it is a season of winds of continental origin and great dryness. The summer third of the year sees a complete reversal of this condition in a flow from sea to land of the moist winds of the southwest monsoon (Plate II); this consequently is a season of much humidity and cloud and frequent rain. Between these principal seasons of the year are the transitional periods of the hot weather months, April and May, and of the retreating southwest monsoon, October and November. The causes determining the monsoon currents are many and complex, but the fundamental cause is certainly the difference of temperature in the winter and summer months respectively between southern Asia on the one hand and the Indian Ocean and China seas on the other. The dominating factor in this drama is the great High Pressure Belt over Siberia in the winter months and which is replaced in the summer months by a low pressure area in Northwest India and West Pakistan. In the establishment of the southwest monsoon current, the Himalayan mountain system plays a vital role.

Meteorologically, the year in India may be divided into the following four natural periods :—

(*a*) The winter period (December to March) when northeasterly winds of land origin extend uninterruptedly over India and the Indian seas up to the equator.

(*b*) The pre-monsoon or the hot period (April to June), characterised by a gradual extension northwards of the oceanic air over the Indian seas and over India and terminated by the establishment of the southwest monsoon.

(*c*) The monsoon or the rainy period (July to September), when southwesterly winds of oceanic origin prevail over the Indian seas as well as over the country.

(*d*) The post-monsoon period (October and November), when the oceanic air retreats southwards from the Indian seas and is replaced by northeasterly winds of land origin.

NORTHEAST MONSOON

The northeast monsoon is fully established in the Indian land and sea areas in the beginning of January when temperature is lowest in the Asiatic continent. There is then a belt of high pressure with anticyclonic conditions stretching from the west Mediterranean to Central Asia and northeast China. Clear skies, fine weather, low humidity, large diurnal range of temperature, and light northerly winds are the usual features of the weather in India during this period, broken only at intervals by weather disturbances which originate in the Mediterranean Sea and which pass eastwards across Persia and Northern India, often into China.

These disturbances are ordinarily less intense than, but similar in type to, the depressions of European latitudes. The precipitation accompanying them is small in amount, but very important for the winter crops of India. Some in their eastward passage give light rains over the whole of Northern India, while others which confine their activity to the extreme north give moderate to heavy rain in the Punjab plains and Kashmir, and heavy snowfall in the higher Himalayas. The disturbances are attended by marked temperature effects, a rise occurring in front of them while in the rear unusually dry clear weather prevails, as a rule, with stronger and cooler westerly winds. During this period of the year, rainfall is greatest in the northwest and decreases towards the south and east; dry weather prevails generally in the Peninsula. The distribution of temperature is almost similar to that of rainfall, the weather being colder in the northwest than in the east and south.

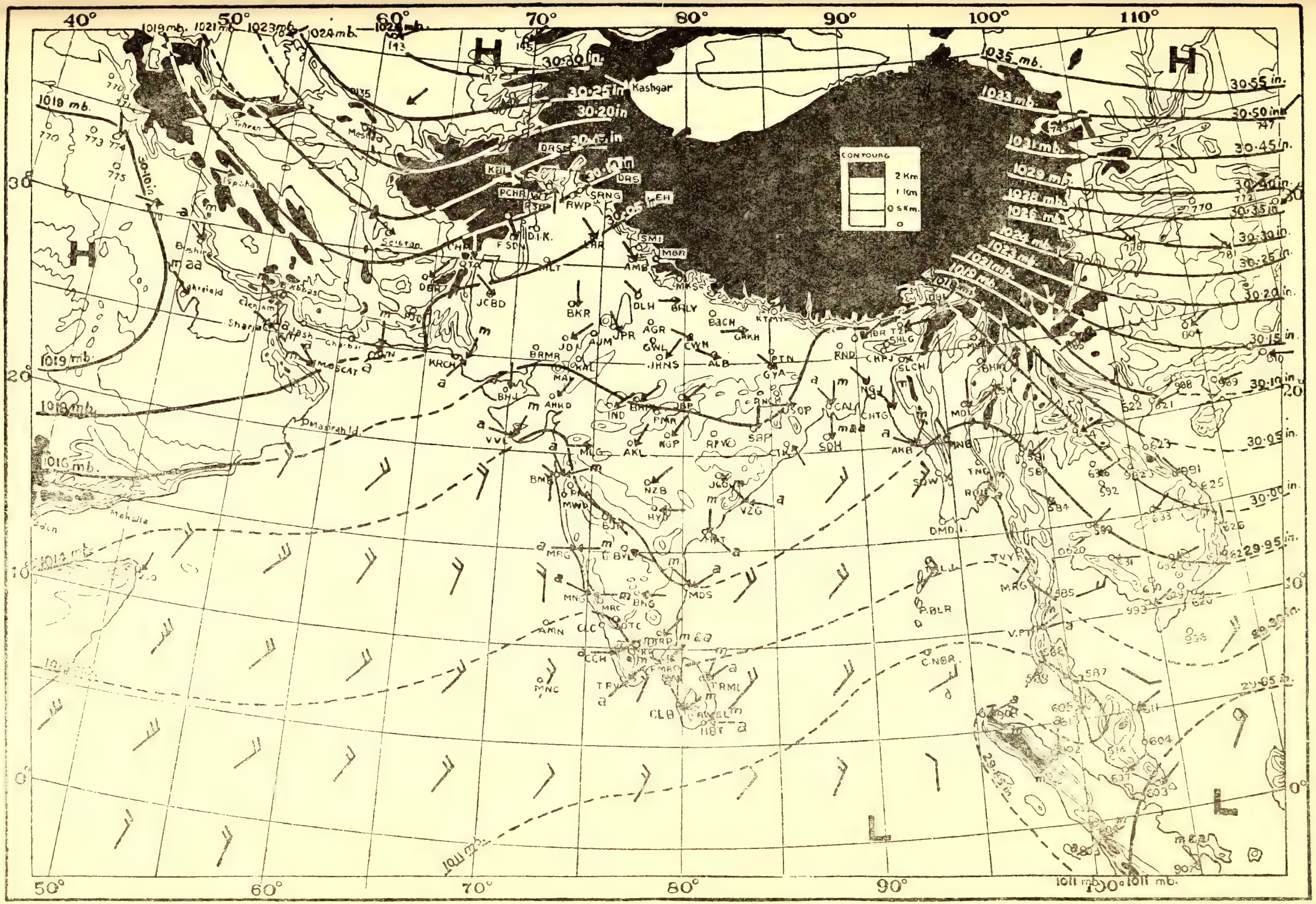
The hot weather period of March to May is one of continuous increase of temperature and decrease of barometric pressure in North India, of continuous decrease of temperature in the south Indian Ocean and adjacent land areas of Africa and Australia and of intensification of anti-cyclonic high pressure area in the south Indian Ocean. There occurs a steady transference northward of the area of greatest heat in India, and simultaneously of the equatorial belt of low pressure of the winter season. In March the highest day temperatures, about 100° F., occur in the Deccan; in April the area of the highest day temperatures, from 100° to 110° F., lies over the south of the Madhya Pradesh and Gujarat; while in May the seat of greatest heat is northern India, and especially the northwest desert, where temperature often reaches 120° F. or over. The area of lowest pressure lies over Rajasthan, Sind and Thar Desert and a trough of low pressure extends from Rajasthan to Chota Nagpur.

A local air circulation with this trough as centre, exists over India and causes indraughts from the adjacent seas of southerly winds across the Bengal coast and of northwesterly winds across the Bombay coast. The land and sea winds give rise to large contrasts of temperature and humidity and consequently to violent local thunderstorms, especially in Bengal, where they are usually called 'Nor'westers'. These are sometimes of tornadic intensity and very destructive. During this period dust-storms and dust-raising winds are more common in North India than in other parts.

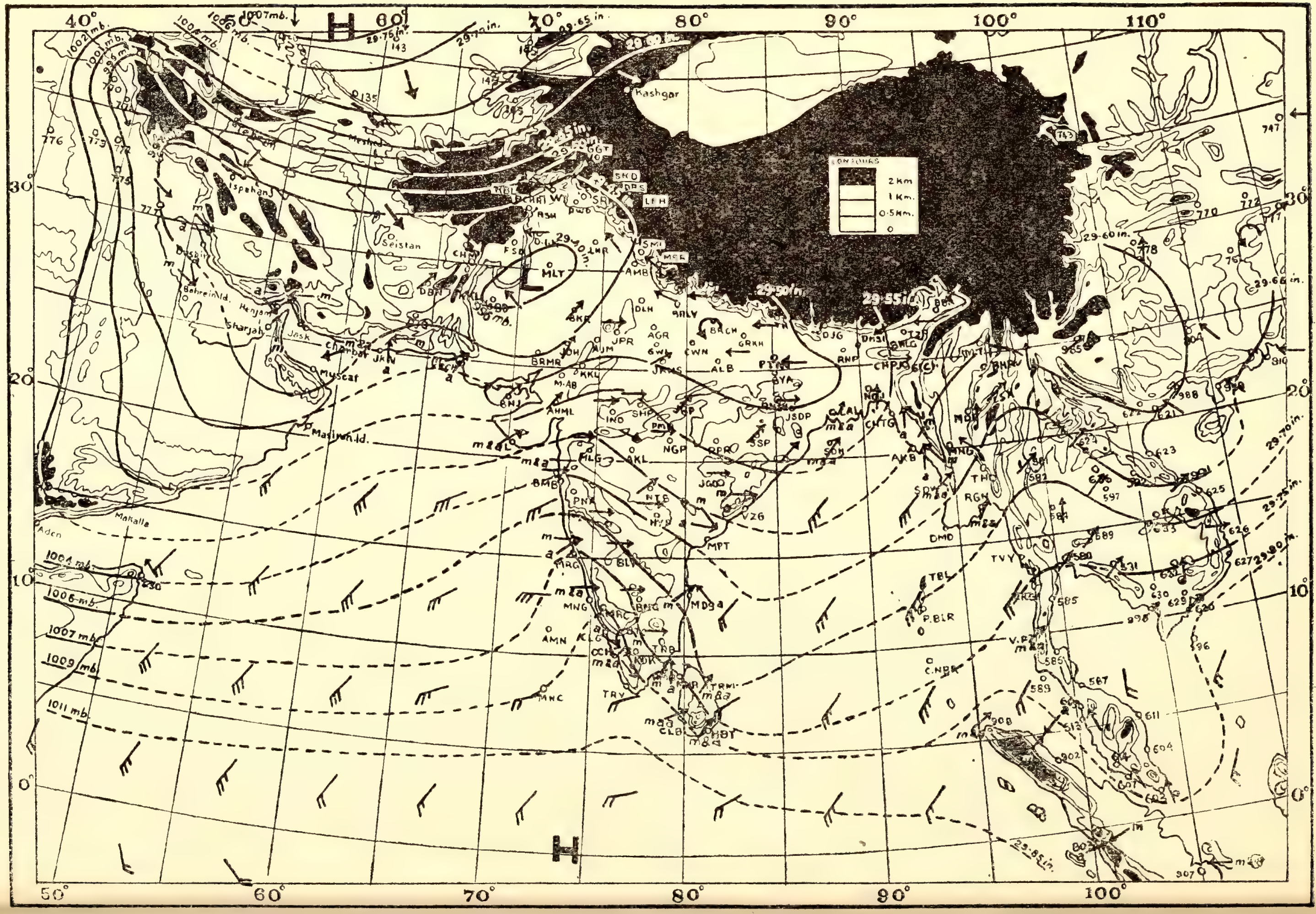
SOUTHWEST MONSOON

Towards the end of May the air circulation over India becomes more and more vigorous until, almost abruptly, in most years the southeast trade winds from south of the Equator are induced northwards into the Arabian Sea and Bay of Bengal and caught up in the Indian circulation; in other years, the establishment takes place by a slow process. This relatively cool as well as humid current, known as the southwest monsoon, bursts on the Malabar coast ordinarily during the first five days of June. It gradually extends northwards and is usually established over most of the Indian areas by the end of June. The current before reaching India has a travel of more than 2,000 miles over sea, and is consequently saturated. It is the great rain-bearing current for most of India.

The orographical features of India are of great importance in modifying the flow of the monsoon currents and the distribution of monsoon rainfall. The Himalayan ranges to the north and the Burma ranges to the east are equivalent to two sides of a box, through the other two sides of which the monsoon currents enter the country. The southerly or Bay of Bengal current is naturally deflected by the two sides of the box northwards through Bengal, and then westwards up to the Gangetic Plain. The Arabian Sea current, on the other hand, surmounts the Ghats on the west coast, causes copious rain there,



MEAN PRESSURE & PREVAILING WIND—JANUARY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Jask
Chahbar
Muscat
Masirah Id.
Makalla
Aden
MLT
KBL
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DRS
LEH
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SMI
MSR
AMB
DLH
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AGR
JPR
BKR
JDH
AJM
BRMR
GWL
CWN
BRCH
GRKH
ALB
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GYA
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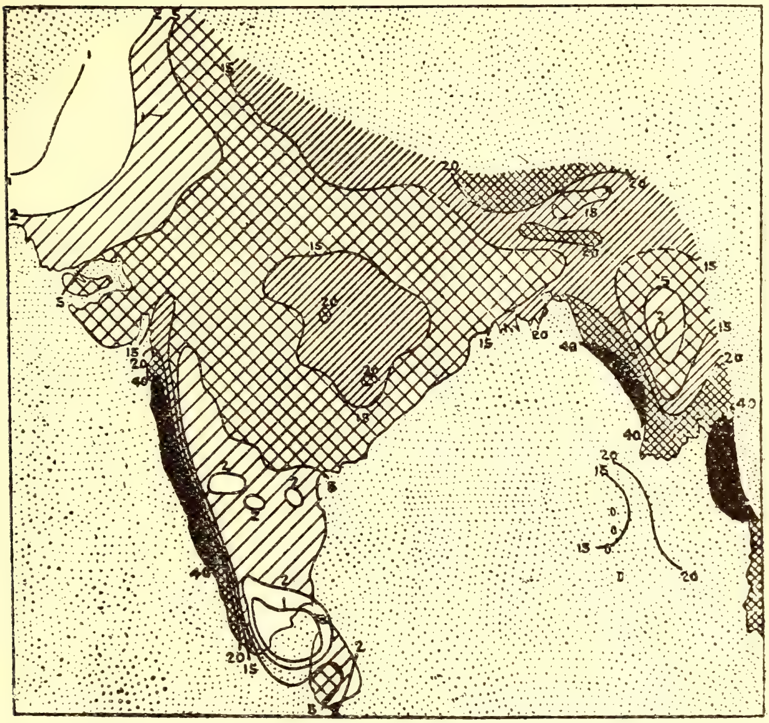
advances over the Deccan and Madhya Pradesh, and generally meets the Bay of Bengal current along the line of the trough of low pressure over the Gangetic Plain, normally extending from Orissa to northwest India. At the eastern end of the trough over the north Bay of Bengal, depressions frequently form. They intensify the monsoon rainfall and travel from the head of the Bay along the trough to Saurashtra, Rajasthan or the Punjab, and cause widespread rain and occasionally local floods.



July Rainfall.

Further, the trough is not stationary but moves north or south of the normal position and affects the rainfall distribution as it moves. Consequently the monsoon period is not one of continuous rain in any part of India. Bursts of general rain alternate with breaks, partially or generally as the case may be. The pulsatory character of this action and of the rainfall precipitation is one of the most important features of the monsoon period meteorologically, as it is also economically for the proper growth of the crops. On the average it may be said that the strength of the currents and the accompanying rainfall increase from June to July and remain steady till about the end of August. The monsoon then begins to retreat from northern India. Taking the country as a whole, India gets 42·8 inches of rainfall during the monsoon months, of which 3·1 inches fall in May, 7·9 in June, 11·2 in July, 10·3 in August, 7·0 in September and 3·3 in October. The distribution of rainfall in July is shown in the above text figure.

There are four important variations from the normal in the monsoon rain over the country. Firstly, the commencement of rains may be considerably delayed over the whole or a large part of India; secondly, there may be a prolonged break or breaks lasting over the greater part of July or August; thirdly, the rains may terminate considerably earlier than usual; and lastly the rains may be considerably heavier than usual over one part than over another. The last constitutes the most common abnormality.

Post-Monsoon

The post-monsoon or retreating southwest monsoon period—the end of the wet season—forms a transition period leading up to the establishment of the conditions of the dry winter season. This transition begins in the early part of October and is usually not completed until mid-December. The Arabian Sea monsoon current retreats southwards from Rajasthan, Saurashtra and the Deccan by a series of intermittent actions.

The Bay of Bengal current retreats similarly down the Gangetic Plain. The low pressure conditions previously prevailing in north India are obliterated by October, and are transferred to the centre of the Bay at the beginning of November and to the south of the Bay by the beginning of December. By the end of that month the belt of low pressure usually passes out of the Bay limits into the equatorial belt, where it forms a permanent feature of the meteorology of the Indian Ocean during the next three months. Similar conditions obtain in the Arabian Sea also. This retreat of the low pressure to the south of the Bay is associated with dry weather in northern India but with more or less general rain on the Madras coast districts and over the eastern half of the Peninsula, where October and November are often the rainiest months of the year.

Rainfall Variations

From the foregoing description, it will be understood that the distribution of rainfall over India depends largely on its orographical features. If the hills and mountains of India were effaced, the country would receive much less rainfall. It will also be seen that the rainiest season in most provinces is the monsoon period, June to September; that rainfall during the cold weather is scanty: and that the important rains in southeast Madras are those of October to December. Stress has also been laid on the great variability of monsoon rainfall in time and space in any one year. The variations in the amount of precipitation received from year to year are also surprisingly large. The annual rainfall of the Indian region, excluding Burma, is 42 inches and variations from this normal as great as + 12 inches and –8 inches occurred in 1917 and 1899 respectively. A long break in the monsoon, or an abrupt termination of rains, is disastrous to crops and produces droughts or famines.

On the other hand, tracts of country are sometimes deluged with rain and suffer distress through excessive flooding. These heavy downpours occur chiefly near the tracks of the cyclonic depressions of the monsoon months or of the cyclones that occasionally advance inland from the Bay of Bengal or Arabian Sea. A fall of 10 inches to 20 inches in a day is by no means a rare occurrence. We have records of rainfall in the plains as high as 25 inches in 24 hours at Purnea in Bihar and 28 inches in Bombay.

The following table (Table I) summarises the essential facts about India's rainfall based on observations made during the period 1875 to 1950:—

TABLE I

Facts about India's Rainfall

	Normal Rainfall (inches)	Extremes of variations Amount and Year	Standard deviation (inches)	Limits (in percentage of normals) within which rainfall is expected to be on a 4 to 1 chance of success
Monsoon Rainfall (June to September)				
Northeast India ...	52·6	− 9·9 1884 + 8·0 1922	4·1	± 10
Northwest India ...	19·4	−11·6 1877 +14·0 1917	4·6	± 30
Peninsula ...	34·1	−16·6 1899 +10·3 1878	5·1	± 19
Winter Precipitation (January to March)				
Northwest India ...	2·8	− 2·1 1902 + 9·7 1911	1·3	± 58

TEMPERATURE AND CLIMATES

During the first half of the year, from January to June, the increase of temperature by solar action is greater than the loss by radiation and other actions, and hence temperature rises more or less steadily in conformity with the increasing elevation of the sun. During the remainder of the year, the balance is the other way and temperature steadily decreases from July to December. Though in most countries July and August are as hot as, or hotter than June, this condition does not prevail in India owing to the cloud and rains of the southwest monsoon. The annual variation of temperature is small in the extreme south and increases rather rapidly northwards up the east and west coasts of India. It is twice as great at Bombay as in Malabar; it is from eight to ten times as great at stations in the north Deccan and northern and central India, and is greatest in the most inland stations of the driest tracts, Rajasthan and the Punjab. The difference between the minimum and maximum temperatures on a day, called the diurnal range, is much smaller in the wet than in the dry season, and at coast stations than in the interior. It is about 12°F. on the west coast of the Peninsula, and rises to 30°F. on the mean of the year in the Punjab. As already indicated, different parts of India exhibit very great diversity in respect of their climatic features.

Northern India alone, in its most easterly and most westerly provinces—Assam on the one hand and Rajasthan on the other—presents us with the greatest possible contrast of dampness and dryness, and when we further compare the most northerly province, the Punjab, with the most southerly, namely Travancore, we find in the former a continental climate of the most pronounced character—extreme summer heat alternating with winter cold that sometimes sinks to freezing point—and in the latter an almost unvarying warmth in conjunction with a uniformly moist atmosphere that is especially characteristic of the shores of a tropical sea. In addition to this heterogeneity on the plains, there is a further variety to be found on the hills.

The hill stations are situated along the Himalayas and on the Ghats in the Peninsula. In all cases their atmosphere is cooler and damper than that of the neighbouring plains; but while those in the northwest Himalayas are subject to great vicissitudes of heat and cold, dryness and dampness, in the course of the year, those of southern India are comparatively uniform in these respects. Their fine clear season is shorter than at the northern stations, and by no means so dry.

The mean maximum and minimum temperatures at a few stations in India are given in Table II (opposite).

Cyclones and Depressions

Besides the setting in of the monsoon early in June, its extension into India during June and July, and finally its retreat southwards in September and October, we have also to consider the other major phenomena like cyclonic storms and depressions.

The cyclones which form in the Bay of Bengal and the Arabian Sea in the transition periods (April-June and October-December) are generally of great intensity and often have an inner area of hurricane winds and calm centre. In these storms, oval or circular in shape, the air moves in converging spirals in a left-handed direction against the hands of a clock. The winds become fiercer and fiercer as the centre is approached and reach hurricane force near it. In the innermost central zone of some ten miles diameter the wind suddenly falls off to a calm or light air, and the barometric pressure there often marks an inch, and sometimes as much as two inches, below normal.

Cyclones generally die away soon after they reach land, but in the coastal districts which they touch may cause great havoc through high winds, torrential rain and—most destructive of all in low-lying districts—storm waves. The latter are due to the huge masses of sea water swept forward by the storm and, when aided by a high tide, may inundate low-lying land to a depth of 20 feet. The storm wave accompanying the Bakarganj cyclone of 1876 was one of the most destructive on record; about a hundred thousand people were drowned in half-an-hour on the alluvial flats of the Meghna, while an equal number died from the epidemics of fever, cholera and other diseases which almost invariably follow a storm wave. As recently as 1942, a storm wave caused great havoc in Contai district of Bengal.

TABLE II

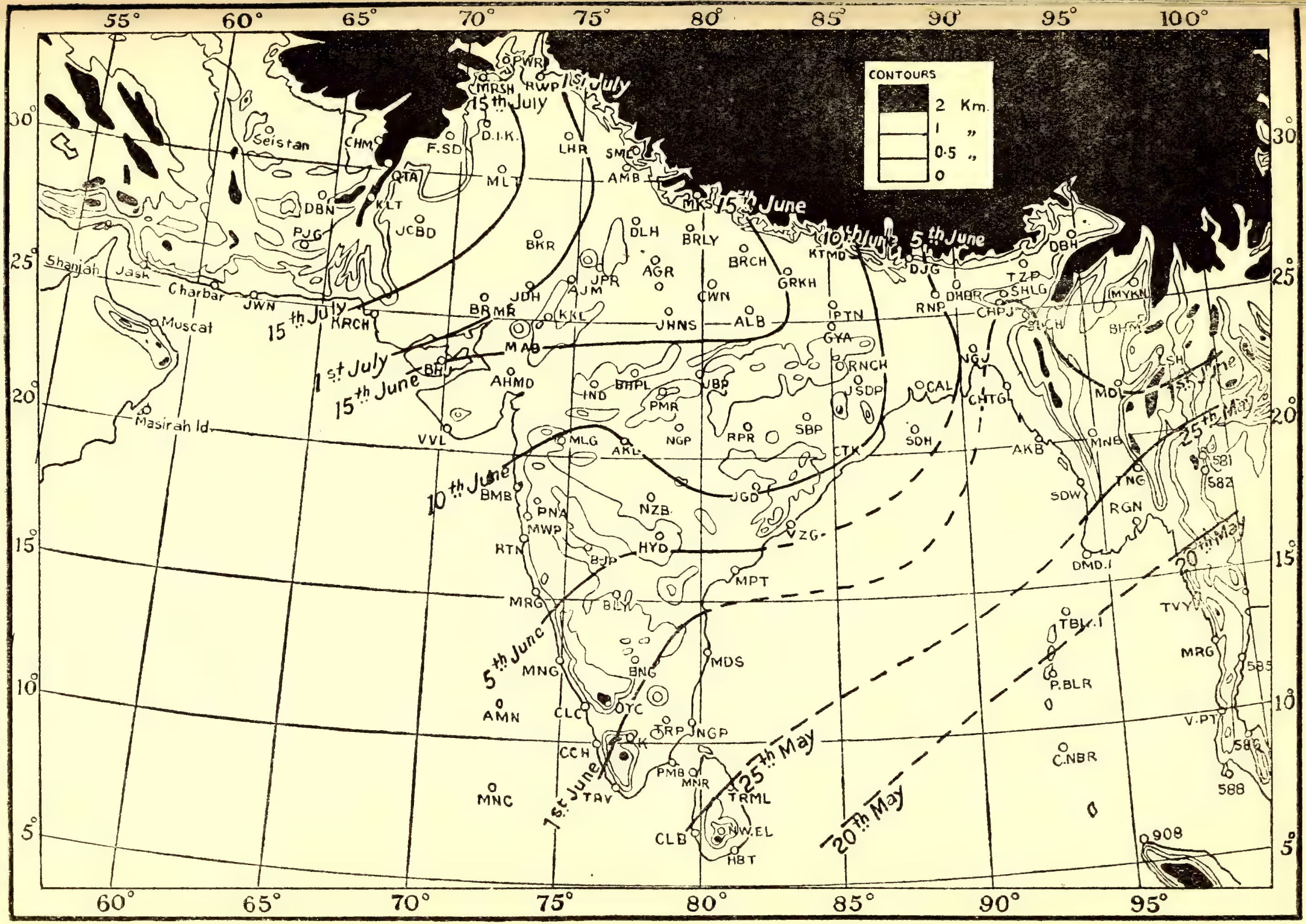
Mean Maximum and Minimum Temperatures

Station	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Highest Maximum	Lowest Minimum
Jodhpur ...	76·9 50·5	80·6 53·3	90·9 62·7	100·2 72·5	106·0 79·8	103·8 82·2	97·5 80·3	93·1 77·7	94·8 75·5	96·4 67·8	88·8 58·6	79·6 52·2	121·3	28.1
Delhi ...	70·0 47·9	74·6 51·7	86·0 61·6	97·9 72·8	104·0 80·2	103·3 83·6	94·9 81·1	92·4 79·8	93·0 77·1	91·6 68·4	82·2 56·7	72·9 48·9	118·0	32·5
Agra ...	74·2 43·8	78·5 46·9	90·2 55·8	101·7 67·8	107·5 77·0	105·6 83·4	95·0 80·2	91·7 78·9	93·1 75·6	92·9 62·7	85·5 49·5	76·9 44·4	120·3	33·9
Allahabad ...	74·4 48·0	79·5 51·9	91·9 61·7	102·8 72·0	106·6 79·6	102·1 82·7	92·8 79·8	90·0 78·6	91·5 76·9	91·1 67·5	83·4 55·3	75·7 47·7	119·8	34·1
Jubbulpore ...	77·5 48·6	81·5 52·4	91·8 60·5	100·8 70·2	105·3 78·5	97·8 78·9	86·7 75·0	84·6 74·0	87·2 72·8	87·7 64·2	82·0 53·2	77·0 46·7	114·8	31·9
Patna ...	72·7 50·9	77·5 54·2	89·5 63·9	99·0 73·3	99·7 77·7	95·7 79·8	90·5 79·8	89·1 79·4	89·5 78·8	88·4 72·8	81·7 61·0	74·1 51·8	114·4	36·3
Calcutta ...	77·5 55·6	82·3 60·3	91·0 69·4	95·5 75·7	94·6 77·6	91·3 78·8	88·6 78·7	87·8 78·5	88·2 78·1	87·4 74·5	82·2 64·7	77·0 56·0	108·2	44·2
Tezpur ...	73·6 52·4	76·0 55·7	82·6 61·8	83·4 67·1	86·9 72·3	88·8 76·6	89·2 77·6	89·0 77·7	88·6 76·5	85·8 71·1	80·5 61·4	74·5 53·5	98·1	42·8
Sambalpur ...	81·7 55·1	86·6 59·9	95·8 67·1	103·2 75·2	106·2 81·1	97·1 80·5	87·7 77·3	86·9 77·1	88·8 77·0	88·8 71·5	83·8 61·8	79·7 53·7	117·3	40·1
Madras ...	85·2 67·3	87·1 68·0	89·5 71·7	92·4 77·1	97·9 80·9	98·3 80·6	95·3 78·5	93·7 77·2	92·7 76·6	89·6 74·6	85·7 71·9	83·9 69·3	113·0	57.5

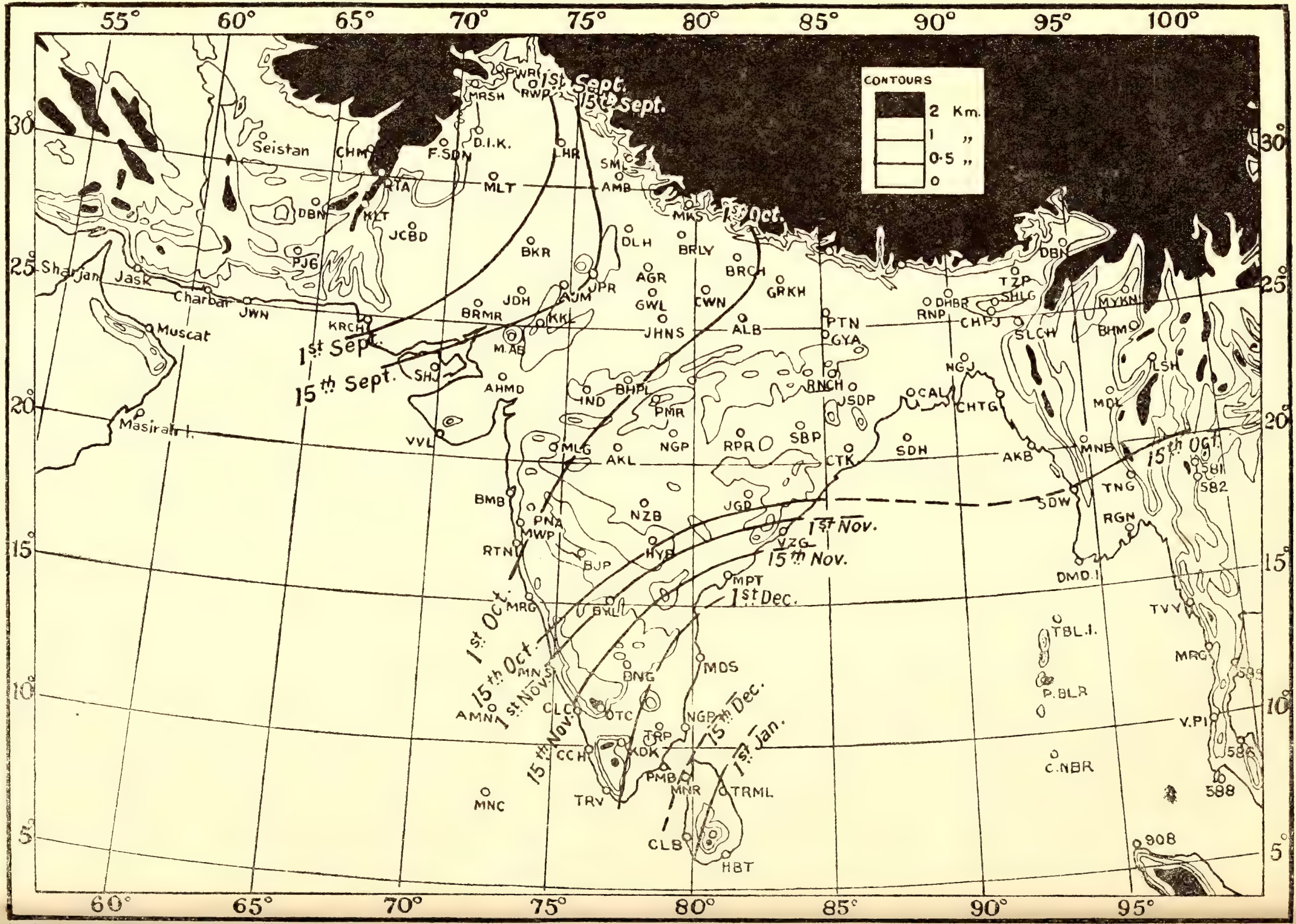
TABLE II—(*Contd.*)

Mean Maximum and Minimum Temperatures

Station	Jan.	Feb	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Highest Maximum	Lowest Minimum
Waltair ...	80·8 67·9	83·8 71·1	87·3 74·7	89·7 78·3	92·0 80·8	91·2 80·2	89·0 78·6	88·8 78·2	88·4 78·1	88·0 76·4	84·3 72·7	80·8 68·1	111·4	59·6
Bangalore ...	80·8 57·5	86·2 60·2	91·1 64·8	93·5 69·4	91·7 69·2	84·9 66·9	82·2 66·0	82 0 65·8	82·3 65·6	82·1 65·2	79·8 62·2	78·9 58·5	100·8	45·8
Mangalore ...	89·2 70·6	88·6 72·3	90·1 75·7	91·7 78·4	91·3 78·7	85·3 74·6	83·9 74·1	83·7 74·1	84·5 74·1	86·1 74·5	88·2 73·4	89·3 70·8	100·1	59·8
Hyderabad (Begumpet) ...	84·2 59·9	89 7 64·2	96·7 70·1	101·2 76·2	103·1 80·0	94·5 76·1	87·6 73·3	85·8 72·5	86·4 72·3	88·4 69·4	84·5 63·2	82·4 58·3	111·9	47·8
Poona ...	86·1 53·3	90·6 55·2	97·1 62·1	101·1 68·9	98·8 73·0	89·0 74·0	82·8 71·9	81·7 70·5	84·6 69·1	89·4 66·5	86·5 58·9	84·7 53·0	110·0	38·8
Ahmedabad ...	84·8 57·7	87·9 59·5	96·9 67·2	104·3 74·4	107·4 79·2	101·3 80·9	93·1 78·5	90·0 76·8	92·9 76·1	97·3 72·4	92·9 65·5	86·4 59·3	117·8	36·0
Bombay ...	83·0 67·0	83·0 67·0	86·0 72·0	89·0 76·0	91·0 80·0	89·0 79·0	85·0 77·0	85·0 76·0	85·0 76·0	89·0 76·0	89·0 73·0	87·0 69·0	100·0	55·9
Trivandrum ...	84·0 72·3	85·6 73·7	87·6 76·5	88·0 78·2	86·7 77·9	83·1 75·6	82·2 74·8	82·5 74·8	83·1 75·0	83·0 74·9	82·8 74·1	83·3 72·9	93·5	63·0



THE SOUTHWEST MONSOON—NORMAL DATES OF ONSET



G.P.Z.P. POONA. 1943.

The principal cyclone months in both the Arabian Sea and Bay of Bengal are May, October and November. They may also occur in April, September and December, and, particularly in the Arabian Sea, in June, on the advancing front of monsoon air. On an average 1 or 2 severe cyclones may be expected to form in the Indian seas in the pre-monsoon period, and 2 or 3 in the post-monsoon period.

EASTERN DEPRESSIONS

The fluctuations in the intensity of the monsoon itself are to a large extent associated with a series of depressions which mostly originate (or, when they are coming from farther east strengthen) at the head of the Bay of Bengal and travel in a northwesterly direction across the country towards N.W. India, causing heavy rainfall along their track. The frequency of such depressions is 3 or 4 in a month during the monsoon months (June to September).

WESTERN DEPRESSIONS

During the period November to May a series of western depressions enter India through Baluchistan and the N.W. Frontier and move eastwards across north India towards N.E. India (Assam-Bengal). These depressions cause cloudy weather and light rains in the plains with snowfall in the Himalayas and are followed by cold waves. Their frequency is on the average, 2 in November, 4 to 5 per month during December to April, and about 2 in May.

CHARACTER OF THE S.-W. MONSOON RAINFALL

Figs. 4 and 5 show the normal dates of onset and of withdrawal of this monsoon in different parts of India. The actual dates of onset as well as the intensity and distribution in time and space of the monsoon precipitation vary from year to year. It will be noticed that there is a considerable variation not only in the dates of establishment but also in the speed with which the monsoon current moves from the Travancore-Cochin area in the south towards Kolaba in the north (near Bombay).

As the major agricultural operations have to synchronize with the monsoon rains, the importance of an advance knowledge of dates of establishment of the monsoon in different parts of the country, the spells of rain and breaks in rain which occur during the season, cannot be over-emphasized.

For an analysis of floods and droughts, we consider the total rainfall during the period June to September. If the deviation of the actual rainfall in a year is more than about twice the mean deviation, that year is defined as a year of flood or drought according as the departure is positive or negative. The results of the analysis from 1875 to 1945 are given in Table III. In this table the '●' sign and '○' sign indicate rainfall in excess and in defect of the normal by an amount more than twice the standard deviation.

If we study the distribution of floods and droughts in the various subdivisions in each year, we see that the years 1877, 1899 and 1918 stand out very prominently as years of general drought. It will be recalled that these were actually years of great famine and distress. The year 1920 was one of partial drought, only the northwest and central parts of the country being affected. The years of general flood are 1878, 1892, and 1917. In two instances at least (1877, 1878 and 1917, 1918) droughts and floods occurred in adjacent years, but there is usually no regularity in time in the distribution of droughts and floods.

Heavy Rainfall

If we examine the frequency of heavy rainfall over India we find that :—

(i) Fall exceeding 5 in. in 24 hours have occurred over the whole of India excluding N.E. Baluchistan and parts of the N.W. frontier.
(ii) Falls have not exceeded 10 in. in 24 hours over most of the interior of the Peninsula and in a few districts in the central parts of the country.
(iii) Falls of 15 to 20 in. in 24 hours have occurred all along the west coast including Saurashtra, on the south Coromandel coast, in south Assam, in Bengal, and the foot of the Himalayas.
(iv) A few isolated falls of 20 in. and over have occurred in the plains.
(v) The greatest fall of over 40 in. in 24 hours has occurred at Cherrapunji in the Khasi Hills.

Heavy rainfall is almost invariably associated with the movement inland of storms from the Bay of Bengal and the Arabian Sea. When heavy rainfall occurs consecutively on a number of days and particularly over the catchment areas of rivers, the magnitude of the ensuing floods may well be imagined.

Plate V gives the distribution of the frequency of heavy falls of three inches and above in 24 hours.

Increasing forest-cover, checking erosion, delaying flood-peaks, and training the major rivers, etc., are problems which have begun to demand an increasing attention of the State.

MICRO-CLIMATE

All the foregoing are the large-scale, or macro-climatic, effects of topography, land and sea surfaces. Locally, however, the variation of land-forms creates an infinite variety of smaller climatic differences, called micro-climates. In addition to the micro-climatic effects of various land forms, concave (valley), convex (crest), lakes, swamps, forests, etc., other climatic influences usually of a subordinate nature, are introduced by the presence or absence of vegetation and by human activities.

Vegetation introduces marked influence on the hydrologic cycle. Trees intercept falling precipitation and part of it is evaporated before reaching the ground. Evaporation is also increased by the transpiration of plants. Precipitation that reaches the soil will, on the other hand, not readily evaporate, nor will it run off easily, because the soil of forests has a spongy structure that can absorb and store considerable quantities of water. Inside forests, temperature maxima are lower and minima higher than over open land. The wind speed is sharply reduced at the surface and the relative humidities in the forests are

TABLE III

NORTH-EAST NORTH-WEST CENTRAL PENINSULA.

	ASSAM	BENGAL	ORISSA	CHOTA NAGPUR	BIHAR	U.P. EAST	U.P. WEST	PUNJAB E. & N.	PUNJAB S.W.	KASHMIR	N.W.F.P.	BALUCHISTAN	SIND	RAJPUTANA WEST	RAJPUTANA EAST	GUJRAT	CENTRAL INDIA WEST	CENTRAL INDIA EAST	BERAR	C.P. WEST	C.P. EAST	KONKAN	BOMBAY DECCAN	HYDERABAD NORTH	HYDERABAD SOUTH	MYSORE	MALABAR	MADRAS SOUTH EAST	MADRAS DECCAN	MADRAS COAST NORTH	
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	
1875			●					●			●							●						●							
76														●											○				○		
77					○	○	○	○			○			○	○	○	○	○		○		○		○	○						←
78	●								●			●	●			●			●			●	●		●		●	●	●	●	
79	●				●	●	●																								
1880						○													○												
81																											○				
82					○				●			●	●										●				●				
83			●			○	○	○											●					●							
84	○	○			○								●	●		●				●	●							○	○		
85																															
86					●															○								●			
87																			●	●	●										
88						●												●													
89												●														●					
1890					●	●																									
91		○			○															●								○	○		
92								●	●		●	●	●	●	●				●				●	●	●				●		
93								●		●				●										●	●						
94						●	●	●				●	●			●															
95		○																												●	
96	○		●			○															●					●					
97												●														●	●	●			
98					●	●																									
99					●			○	○			○	○	○		○			○	○	○	○	○	○	○		○				←
1900	○		●					●													●										
01			○		○																										
02										○											○										
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04									○	○		○	○			○				○											
05							○					○		○	○			○				○	○								
06																															
07						○	○			○																					
08					○			●	●		●		●	●	●										●						
09								●		●																					
1910											●	●																	●	●	
11								○		○	○	○	○	○		○							○								
12										○																					
13							○						●					○													
14									●		●	●										●	●	●	●					●	
15				○		●		○	○	○		○	○	○	○	○	○														
16							●				●	●	●				●		●						●				●		
17								●	●	●	●	●	●	●	●		●			●								●		●	
18	●	●				○	○	○		○		○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○			←
19																	●	●		●	●										
1920								○		○	○	○	○						○	○	○	○		○	○					○	
21																															
22		●			●	●																							○		
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39								○				○	○	○																	
1940																															
41							○					○								○	○	○									
42				●				●							●		●			●											
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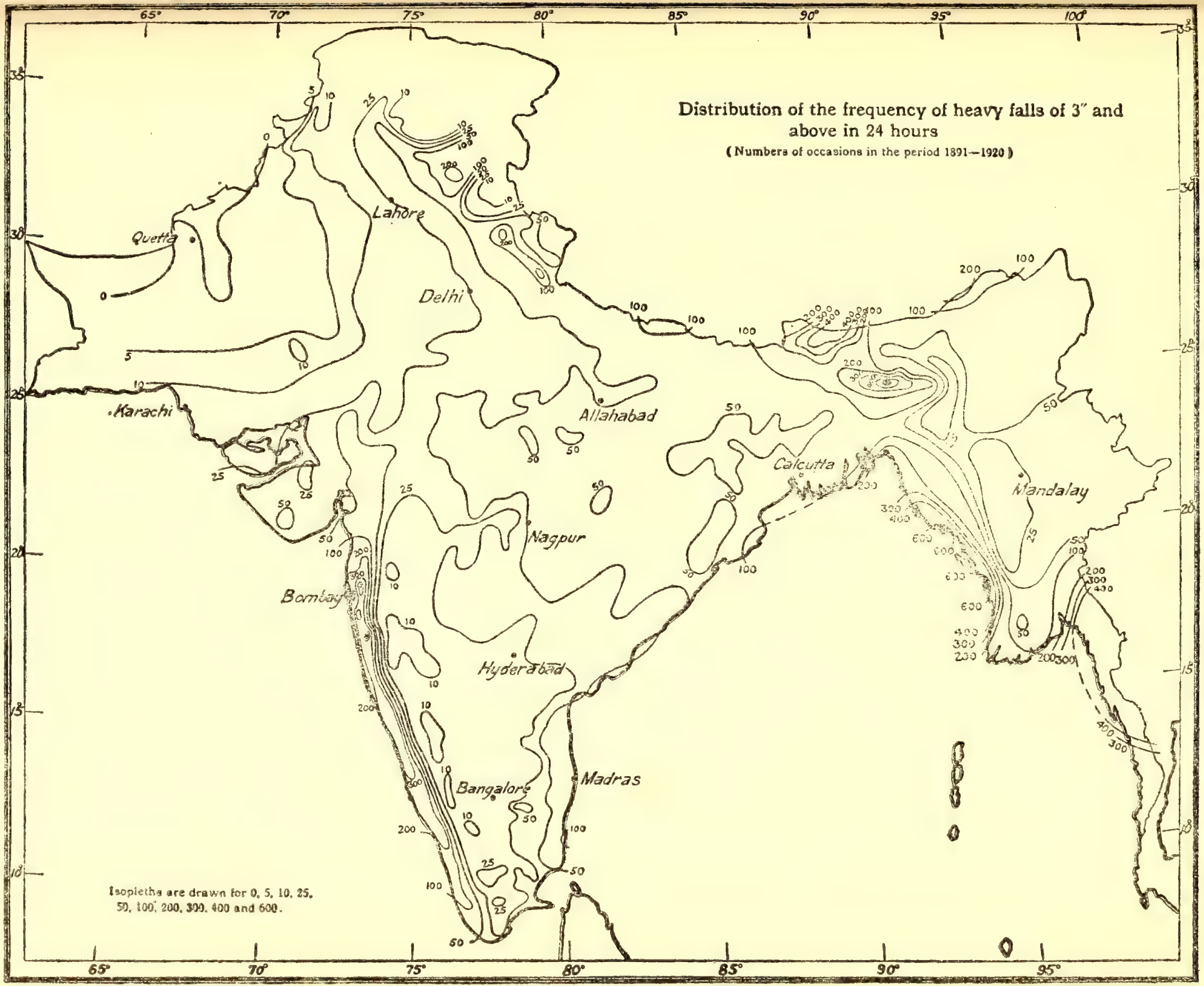
44									●			●	●	●		●	●		●	●											
45																●															
46																	●														
47									▭		▭	▭	▭																		
48						●			▭		▭	▭	▭			○	●														
49									▭		▭	▭	▭						●									●		●	
1910 NORMAL	64·3	56·0	44·5	42·7	41·0	34·4	33·0	18·2	6·6	22·2	8·7	1·9	5·3	11·7	22·9	31·5	31·6	35·1	28·1	41·0	46·4	102·5	26·4	29·5	23·4	22·3	71·5	12·0	15·3	25·0	
MEAN DEVIATION	4·8	5·3	5·0	4·6	6·0	6·2	6·1	4·4	2·2	3·5	2·3	0·9	2·9	3·6	5·3	6·8	5·0	7·1	5·6	5·7	5·2	13·7	3·5	5·8	4·8	3·8	11·7	2·3	3·5	3·3	
LIMIT FOR ABNORMALITY	10·0	10·0	10·0	10·0	10·0	10·0	10·0	6·0	4·0	6·0	4·0	1·2	4·0	6·0	10·0	14·0	10·0	15·0	10·0	10·0	10·0	28·0	7·0	10·0	9·0	8·0	20·0	4·0	7·0	7·0	
FLOODS	4	2	7	1	7	10	4	10	8	3	9	12	11	8	6	7	9	3	8	8	6	2	4	6	7	3	5	6	5	8	
DROUGHTS	3	3	2	2	8	7	8	8	3	9	3	12	8	7	4	7	3	4	4	7	4	6	4	4	5	1	3	5	4	1	
TOTAL	7	5	9	3	15	17	12	18	11	12	12	24	19	15	10	14	12	7	12	15	10	8	8	10	12	4	8	11	9	9	

FLOODS ● AND DROUGHTS ○ IN INDIA.

THE FAMINE YEARS OF 1877, 1899 AND 1918 ARE CONSPICUOUS.

▭ DATA NOT AVAILABLE.



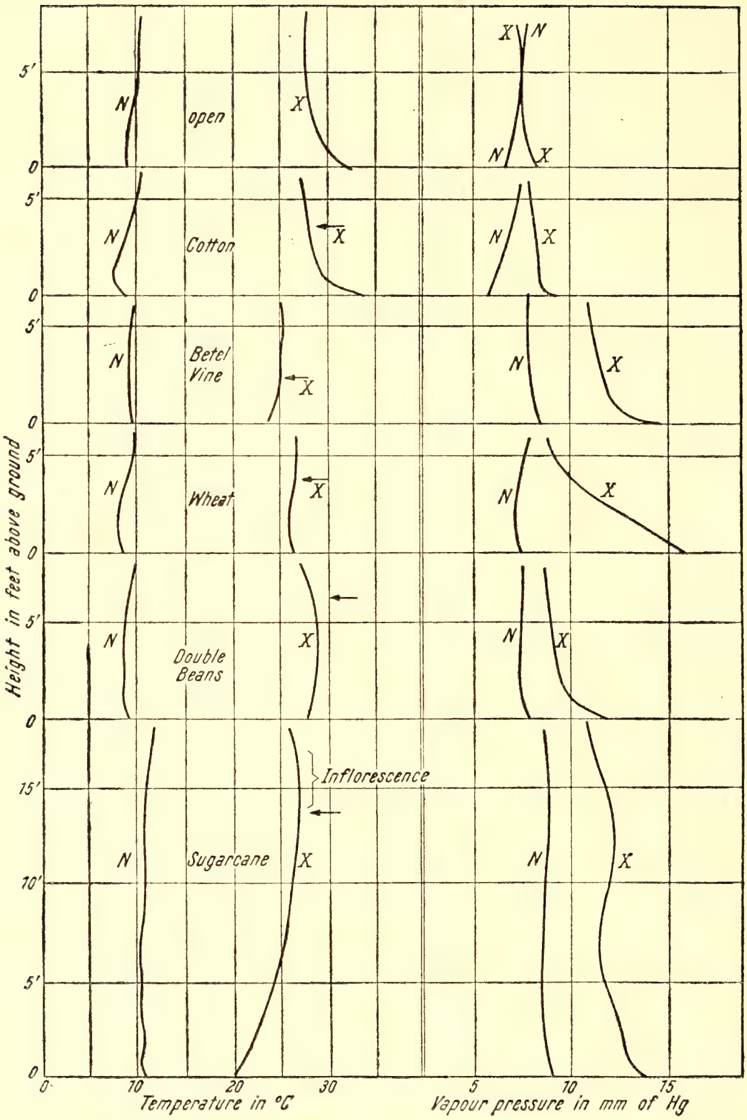
Distribution of the frequency of heavy falls of 3" and above in 24 hours

(Numbers of occasions in the period 1891—1920)

Isopleths are drawn for 0, 5, 10, 25, 50, 100, 200, 300, 400 and 600.

G.P.E S. POONA, 1928.

GRAPH



SOME MICRO-CLIMATES

raised. Tillage of ground will increase water loss from the surface by evaporation, and will also lead to lower minimum temperatures at the surface because of the poor heat conductivity of the loose soil, which will radiate heat without being able to draw on the reservoir at great depths. Such ground will also lead to increased dust blowing at high wind speeds.

Factories and big cities have appreciable influence upon climate. By increasing the atmospheric pollution, they change the radiation balance in the atmosphere over the area. Dust and smoke deplete particularly the ultra-violet part of the solar spectrum. The considerable amount of heat produced in the cities results in an increase of the air temperature. In summer, increased convection causes higher cloudiness over cities, coupled with somewhat higher rain frequencies and amounts.

When soil samples containing only hygroscopic moisture are exposed in the open, they lose water by evaporation from the morning up to the maximum temperature epoch in the afternoon. Thereafter, towards the evening, during the night and until sunrise next morning, the soil absorbs the water vapour from the atmosphere. There is a complementary phenomenon going on in the air layers near the ground. During day-time there is an upward flow of water vapour with the vapour pressure decreasing with height. During night time there is a downward flow of water vapour towards the ground which dessicates the air so that the vapour pressure increases with height.

The micro-climates of plant communities are of fundamental importance in agricultural operations. The air temperature, humidity, wind velocity, evaporation, etc., at different levels above ground inside environments like standing crops and orchards, that is the micro-climates of these environments, show significant and typical deviations from the conditions at the same levels in the open space. A few typical micro-climates for cotton, betel-vine, wheat, double-beans and sugarcane as observed in the Poona Agricultural Meteorological Observatory are shown in the graph (opposite). The curves referring to the minimum temperature epoch are marked *N* while those referring to the maximum temperature epoch are marked *X*. The horizontal separation between the *N* and the *X* curves indicates the diurnal range at the level under consideration. The micro-climatic characteristic depends on the plant density, wind break effect as controlled by the distribution and intensity of the foliage, the canopy effect, wetness of ground, etc.

The healthy growth and normal yield of crops depend upon certain optimum conditions of rainfall, temperature, humidity, wind, cloudiness, etc., in the air and soil layers with which the plant world is concerned. Analysis of existing data has given ample evidence for concluding that of all the 'controls', the climatic factor is the one 'control' which accounts for at least 50 per cent of the variability of crop yields over a series of years. Manure, variety, cultural operations, etc., all combined, account only for the remaining 50 per cent of the variability.

MISCELLANEOUS CLIMATOLOGICAL PROBLEMS

(1) Periodic Variations and Climatic Trends

Ellsworth Huntingdon has utilised field studies in Asia and North America for evidence of progressive, or perhaps a mode of desiccation that occurs in the form of pulsations which endure for a century or more and are then followed by a swing in the opposite direction. There is strong reason to believe that during the last two thousand years there has been a widespread pronounced tendency towards aridity. In drier regions the extent of land available for pasturage and cultivation has been seriously curtailed, and the habitability of the country has decreased. Moreover, in both the drier and the moister regions the change of climate does not appear to have been all in one direction. After a period of rapidly decreasing rainfall and rising temperature during the earlier centuries of the Christian era, there is evidence of a slight reversal and a tendency towards more abundant rainfall and lower temperature during the Middle Ages. This pulsation has been more in evidence in desert regions than elsewhere. Writing about Lake Nagami, north of Kalahari Desert in South Africa, Prof. Schwarz says: 'In 1760 it was dry ; then followed a period, when it was great lake, from 1813 to Livingstone's visit in 1849, when it had begun to decrease: from 1854 until 1861, when it held some shallow water surrounded by reeds: and from 1896 until 1922 when there was no water and the lake was a dry plain'. The restoration of Lake Nagami is regarded as evidence, amongst others, of a cyclic climatic change of period exceeding 100 years.

In arid and semi-arid areas, annual precipitation varies greatly from year to year. Long-time changes in precipitation may be classified into (1) random fluctuations, (2) cyclic fluctuations, and (3) trends. As regards random fluctuations, it may be expected, since there is a large variation in the annual rainfall, that consecutive years will have similar as well as dissimilar amounts. A chance event may happen singly or in random groups. If there are cyclic fluctuations, the variation from the mean should be similar in magnitudes, and should be repeated at regular intervals of time. Walker found between sunspots and the annual temperature of India a correlation coefficient as high as —0·5. This is suggestive of a *cyclic variation* of 11 years, or 22 (or 23) years, or 34 (or 35 years, as in Brückner's 'cycle'), though it is not easy to trace such cyclical variation in a plotted curve of annual precipitation against years.

Trends may be defined as diminishing or increasing average precipitation over a given period. The annual variations obscure the trend in many cases, but in others it is clearly visible in a plotted graph. To determine whether the aridity is increasing or decreasing over any part of Rajputana and adjoining areas, or over Deccan, we have to determine the trend of (a) rainfall at typical individual stations, and (b) over specified areas, such as districts.

The most commonly used method for determining trend is the method of moving averages. The effect of this process is the smoothing out of the annual variations: the greater the number of years in each group the more effectively is the annual variation smoothed out.

A more accurate method is to assume a law, $R_n = a + bn$, where R_n denotes the rainfall in the nth year, and determine the most probable values of a and b by the method of least squares.

Analysing in this way, we find that the rainfall in some of the stations in the Great Indian Desert, in the south Punjab, Cutch and Saurashtra show a definite downward trend. At Jacobabad, which is a typical desert station with long records, the mean annual rainfall for the

26 years ending 1886 was 4·4 inches; for the 52 years ending 1920, it was 4·0 inches; and for the 60 years ending 1940, it was 3·6 inches. At Delhi, the mean annual rainfall for the 36 years ending 1886 was 27·6 inches; for the 55 years ending 1920, it was 26·18 inches; and for the 75 years ending 1940, it was 25·25 inches. These overlapping means definitely show a downward trend of rainfall. Such decrease of rainfall must necessarily lead to an increase of aridity.

(2) Aridity Factor and Precipitation Ratio.

To introduce a numerical expression for aridity as a climatic element, Lang defined in 1920 the 'rain factor', P/T, in which P denoted the mean amount of precipitation in millimetres and T the mean air temperature in degrees centigrade, for a specified period of years. In 1926, Hirth plotted the lines of equal 'rain-factor' called isonotides. P/T has generally the minimum value over the desert region. But this or the form P/(T + 10), introduced by Prof. Maroune, to avoid negative values, which he called 'index of aridity', does not provide a complete description of aridity. Heavy rainfall in one year, followed by little rain in the next 2 or 3 years or what is known as 'rainfall variability' as well as the large diurnal variation of temperature (or range of temperature), called also 'thermal continentality', are major contributory factors for aridity. Accordingly Gorczynski gave the following numerical measure for the percentage of aridity: K × (Latitude factor) × (Range of Temperature) × (Precipitation Ratio.).

The 'latitude factor' was taken to be merely the cosecant of the latitude, (on the ground that 12 cosec (lat.) gives the range of temperature in centigrade scale in most part of the oceans). The 'precipitation ratio' represents the ratio of the difference of maximum and minimum annual precipitation to the average precipitation for a given number of years. The range of temperature is the mean annual range of temperature. When temperature is measured in Fahrenheit scale, the constant K is taken as 5·4, so that the 'percentage aridity' may approach 100 for the worst desert conditions. Calculated on this basis, the aridity of the Sahara is 79% at Colomb Bechar and 65% at Fayium; the aridity is 66% at Salton (California) and 40% in West Rajputana. While this formula is approximate, it indicates the major factors to be taken into consideration in the computation of aridity. A more accurate formula has yet to be evolved.

One of the main contributory causes for the increase of aridity is the destruction of forests and vegetative cover. The formula given above for the percentage of aridity shows that it is directly proportional to the range of temperature. Over barren grounds, the range of temperature is considerably more than that over forests or grounds with a vegetative cover. Therefore, indiscriminate cutting of trees for cultivation, firewood, etc., and destruction of vegetative cover by cows, goats, sheep and other animals must lead to an increase of aridity. The increase of aridity in several parts of India has been partly due to this cause.

Historical evidence has been adduced that western Rajasthan was well-wooded at the time of Alexander and the Maurya empire. Since A.D. 600, the use of forests for firewood and other domestic purposes increased beyond their natural recuperative powers. Thus a vicious cycle was set up. Herds of goats and sheep moved about by the nomadic tribes used up vegetation wherever it existed or appeared. In this way man and his animals contributed, and are still contributing appreciably, to the increase of aridity.

(3) Classification of Climates

Köppen classified the principal climatic zones of the world into five main classes, namely, dry climate, humid meso-thermal climate, humid micro-thermal climate, polar climate and tropical rain climate, and further sub-divided these into a total of eleven climatic provinces. The dry climate (steppe and desert) is distinguished from the others mainly by precipitation limit, while the others are separated from each other by characteristic temperature limits. Thornthwaite, on the other hand, defined the climatic classes based on the effectiveness of precipitation, by which was meant the ratio between precipitation and evaporation at a given place. The statistical value obtained by him for the precipitation-evaporation ratio (P/E) is

$$\frac{P}{E} = 11{\cdot}5\left(\frac{P}{T-10}\right)^{10/9},$$

where P and E are the monthly precipitation and evaporation in inches and T is the mean monthly temperature in °F. This factor is found to bear a close relation to plant growth. According to this basis, the five climatic classes are: Arid (desert), where $P/E < 16$: Semi-arid (steppe), where $P/E = 16$ to 31 ; Sub-humid (grassland), where $P/E = 32$ to 63 ; Humid (forest), where $P/E = 64$ to 127 ; Wet (rain-forest), where $P/E =$ or > 128. The importance of plant cover and agriculture to human culture has resulted in widespread use of these climatic classifications. In India we have regions where one or the other of these climatic types prevail.

(4) Influence of Topography on Climate

The topography, mountains, lakes, etc., have profound influence on climate. The distribution of precipitation is most noticeably affected by mountains. On the windward side there is an increase of precipitation with height, and this is approximately given by the formula

$$P_h = P_o + 0{\cdot}072h,$$

where P_h represents the annual precipitation in inches at height h above the foot of mountain measured in feet, and P_o the annual precipitation in inches at the foot. Thus if at a station at the foot of Western Ghats the annual rainfall is 100 inches, it is 244 inches at a height of 2,000 feet.

The rate of decrease of temperature with height is known as the lapse rate of temperature. It amounts on the average to 3·4 to 3·8 °F. per 1,000 ft., but may vary considerably from this depending on the locality and the season.

(5) Diurnal Variation of Climatic Elements

There is a pronounced diurnal variation of pressure, temperature and humidity at all stations. At many stations in India there is also a clear diurnal variation of rainfall in the months June to September. There is a well-marked tendency to increased rainfall during the dark hours, and as a consequence, the earlier half of the day, from midnight to noon, gets more rain than the latter twelve hours. Thus at Bombay, the analysis of the hourly values of rainfall for the 60 years, 1875 to 1934, shows that during June to September, 35·7 inches were recorded between midnight and noon and only 28·8 between noon and midnight.

(6) Climatological Folk-lores

Climatological folk-lores are prevalent in many countries of the world. In India, too, there are many such folk-lores. Some of these are based on astronomical or astrological grounds, such as those associated with the effect of full-moon or new-moon or the position of planets on rainfall; some of the others are based on climatological experience, such as rainfall lasting for one day only or for three days or for seven days, if it commences on certain specified days of the week in July. While they contain climatological statements in convenient forms, statistical investigations are necessary to determine how often they are true, and if any of them be found to be true more often than one should expect on random chance, the locality to which it is applicable.

This review will make it clear that the climate is the collective state of the atmosphere at a given place during a specified period of time. The climatic conditions depend on the general circulation of the atmosphere and its local modifications. The circulation of the atmosphere is determined by a multitude of processes ; many of these processes are known, but their influence, inter-relation and inter-action are very complex. These make the climate a variable quantity and no analytical and quantitative treatment of all the causes determining the climate can be given in the present state of our knowledge.

THE DESERT LOCUST AND ITS CONTROL

BY

HEM SINGH PRUTHI, Ph.D., SC.D. (Cantab.), F.N.I., F.A.S.
(*Plant Protection Adviser & Director, Locust Control in India*)

&

D. R. BHATIA, M.SC. (HONS.), F.E.S.I.
(*Deputy Locust Entomologist*)

(*With one coloured and two black-and-white plates*)

INTRODUCTION

About half a dozen species of locusts are found in the world, of which the Desert Locust (*Schistocerca gregaria* Forsk.), the Bombay Locust (*Patanga succincta* L.) and the Migratory Locust (*Locusta migratoria* L.) are found in India.

Of these the Desert Locust is the most important. This insect is a denizen of desert, (Col. pl., fig. 1), its belt extending from northern India to western Africa, through Pakistan, Arabia, Iran, etc. In India, its permanent desert homes lie in the major part of Rajasthan, part of Saurashtra, Kutch, Hissar and Mohindergarh districts of the Punjab, and Pepsu[1]. Individual locust specimens are normally found in these and similar outbreak areas in other parts of the locust belt, even when the locust cycle is not on. At such times they are in the 'Solitary phase'. However, when there is a mass and crowded multiplication they become very active, fly together as swarms and are transformed into the 'Gregarious phase': thus a new cycle starts. Since 1863 eight such cycles have occurred, and the ninth cycle is on since 1949. The last cycle was in progress during 1940-47 and the present cycle started, after a lapse of only one year, in 1949. When swarm formation occurs, the area of locust activity extends into Europe, the major part of the African continent, southern U.S.S.R. and Afghanistan, etc. In India the swarms generally invade the northern parts but sometimes reach as far as Assam in the east and Madras in the south. The actual locust breeding areas, however, do not extend beyond the western districts of Uttar Pradesh in the east and northern parts of Madhya Pradesh in the south.

LIFE HISTORY

The locust passes through three stages in its life, viz. egg, hopper (wingless young ones) and adult. Locusts are promiscuous, each

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[1] Patiala and Eastern Punjab States Union.

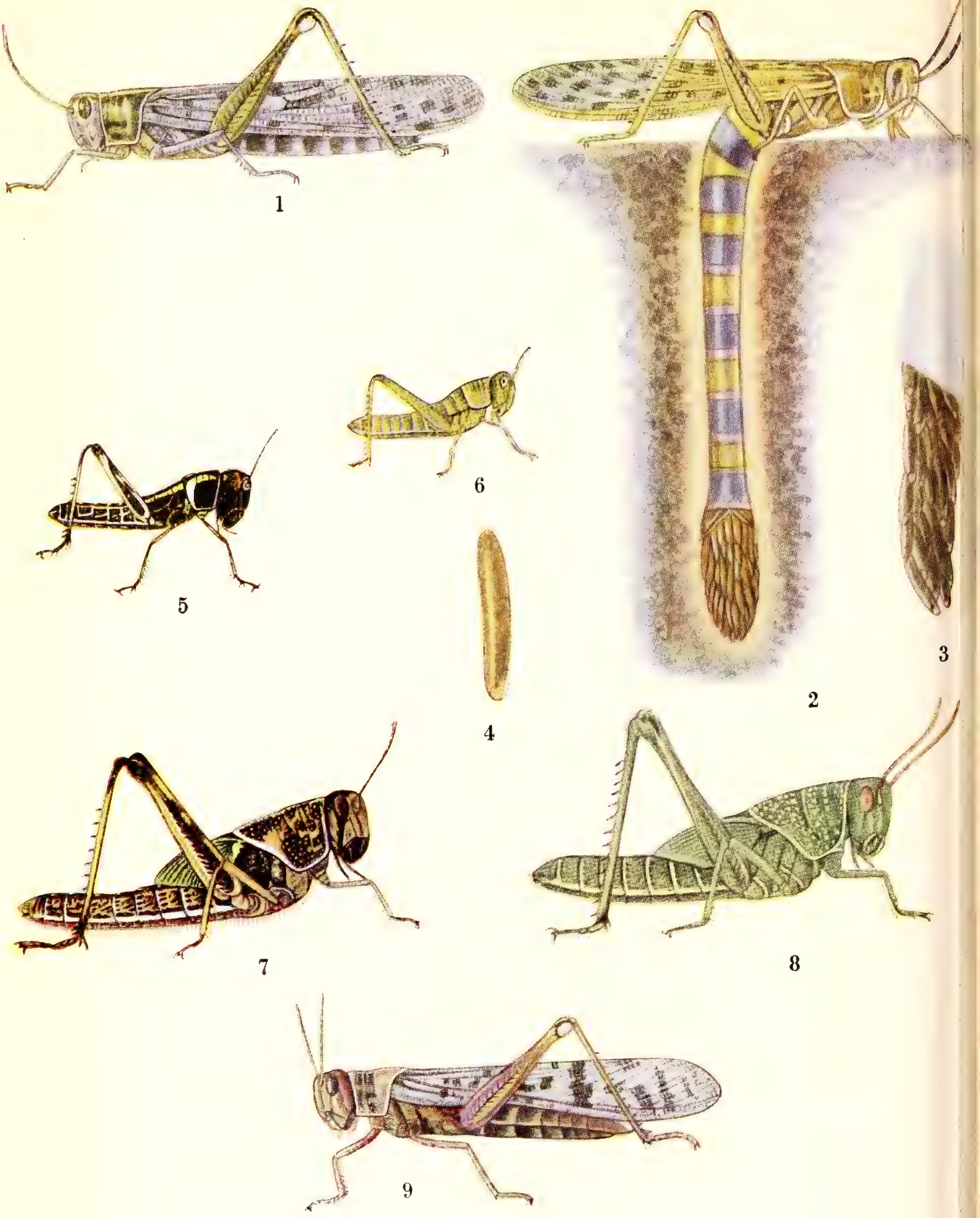


Fig. 1. Adult Solitary Phase—Female
,, 2. Egg-laying
,, 3. Egg-cluster (magnified)
,, 4. Egg (magnified)
,, 5. Hopper—Gregarious phase

Fig. 6. Hopper—Solitary phase
,, 7. Grown up Hopper—Gregarious has
,, 8. Grown up Hopper—Solitary ph se
,, 9. Adult—Gregarious phase

copulating with several individuals of the opposite sex in its life time. There is no courtship. The mature male abruptly mounts the female but copulation takes place only if the latter is in a receptive condition and mood. Otherwise the male is literally kicked off. Once the copulation is firmly established, the female (with the male on its back) freely moves about and may even take to feeding, etc. After the male has actually copulated, the female drills a hole, in moist sandy soil (Col. pl., fig. 2) about 4 to 6 inches deep with the help of chitinized curved ovipositors at the end of her abdomen. A mass of 50 to 100 eggs is laid at the end of this hole and thereafter in the remaining part she secretes a frothy liquid which soon hardens into a water-proof plug. Since locusts in the gregarious phase rest together several egg masses are laid close to one another.

The eggs hatch in about two weeks time during the monsoon. The hatching period is prolonged during autumn and spring and may extend upto four weeks. On emergence the hoppers congregate and march together in bands, eating up all vegetation in their path. They undergo five moults before they acquire wings (Plate I), the hopper stage generally lasting about four weeks during monsoon.

The hoppers of the gregarious phase are black in their early stages (Col. pl., fig. 5) but subsequently, during summer, most of the black pigment disappears and they become yellow with a few black markings. The immature adults are pink (Col. pl., fig. 9) but gradually turn grey and finally yellow when sexually mature (fig. 2). Pink locusts are very active and cause most damage to crops whereas the yellow swarms are not so destructive. Locust swarms and hopper bands generally rest congregated on bushes, crops or trees, etc., at night and mid-day in summer. In summer locusts take wing early in the morning but in winter they do so only after about 10 a.m. The ovipositing swarms, however, might stay in a particular locality for 2 or 3 days.

The hoppers of the solitary phase are generally green without black markings (Col. pl., figs. 6 & 8). In fact their coloration resembles the vegetation on which they live and feed. The solitary adults are grey and do not turn yellow even when sexually mature, so long as they lead a scattered existence (fig. 1).

In addition to the change in colour, the transformation of phase brings about morphological changes also. For instance, in the gregarious phase, the hind wings are longer, the eyestripes six in number and the antennal segments 26, whereas in the solitary phase the hind wings are shorter, eyestripes six to eight and antennal segments 26 to 30. The ratio between the elytra and hind femur gives a fairly accurate indication of the phase of an individual. In the gregarious phase this ratio is over 2.15, whereas in the solitary phase it is upto 2.05. In the intermediate phase the ratio lies between 2.05 ad 2.15.

BREEDING AND MIGRATIONS

There are generally two breeding seasons during a year—spring and monsoon. In the areas where rainfall is received during winter-spring, e.g. Baluchistan, southern Iran, south-eastern Arabia, Red

Sea coasts, Afghanistan, etc., locusts breed in the spring season, the period generally extending upto April-May. In areas where rainfall is received mostly in the S.W. monsoon season, e.g. India, the adjoining Sind-Bahawalpur desert of Pakistan, Anglo-Egyptian Sudan, etc., locusts breed during that period.

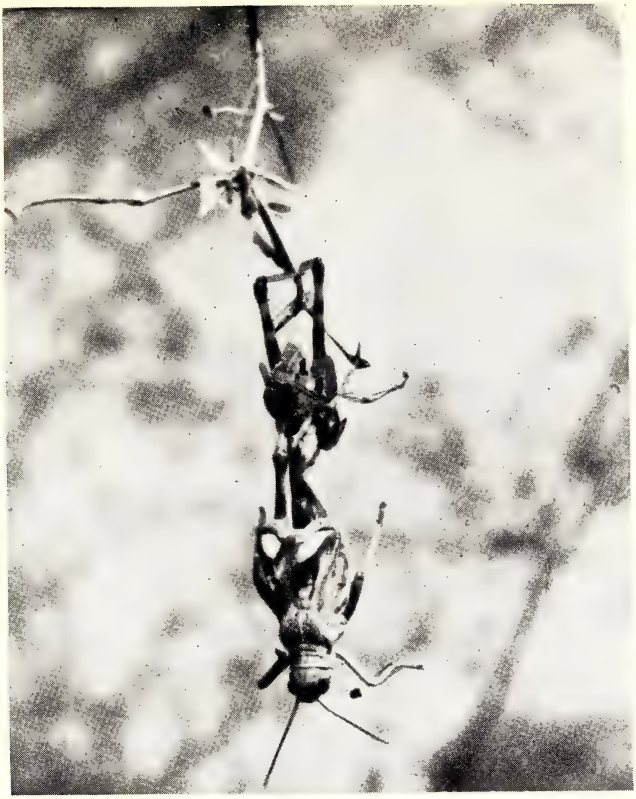
During the swarming period, India is generally invaded by exotic swarms from western countries between May and August. The swarms which invade India before the start of the monsoon in the desert areas, cross over towards east and south, but at the onset of the rains they generally return to the desert parts for breeding. Breeding occurs generally between July and September, but in case the monsoon is a prolonged one, post-monsoon breeding may also occur, extending upto November. If control operations in India or the adjacent areas of Pakistan are inadequate, fresh swarms develop which may invade the cultivated states of Madhya Pradesh, Madhya Bharat, Punjab, Bombay, etc., but normally swarms which escape destruction migrate westwards to the winter-spring breeding areas. Sometimes, however, there is over-wintering in India and spring breeding may also result, such as happened in the Punjab and Pepsu in 1951. Normally, breeding in India occurs during the monsoon only.

NATURE AND EXTENT OF DAMAGE

Swarms covering 300 square miles are on record. Often they are so dense that they mask the sun. The distance covered in a flight is sometimes enormous. A swarm was discovered in mid-Atlantic, 1,500 miles off the coast, indicating that it had flown this long distance at a stretch. In India they usually travel at about 150 miles a day. In the course of their flights the swarms, particularly when sexually immature, cause immense damage to crops and other vegetation. They are capable of consuming the entire vegetation of a locality, devastating crops, and completely defoliating fruit and shade trees (Plate II). The hoppers also cause incalculable damage to vegetation and crops. They even enter houses, fall into wells and make life miserable. At times they block railway traffic, by making the line slippery on account of their crushed bodies. Due to their ravages on fodder and pastures there occurs a heavy mortality among cattle, goats and sheep, and sometimes people have to leave their homes in search of livelihood elsewhere. During the 1926-31 cycle, direct losses to crops alone amounted to about 10 crores of rupees.

LOCUST CONTROL ORGANISATION

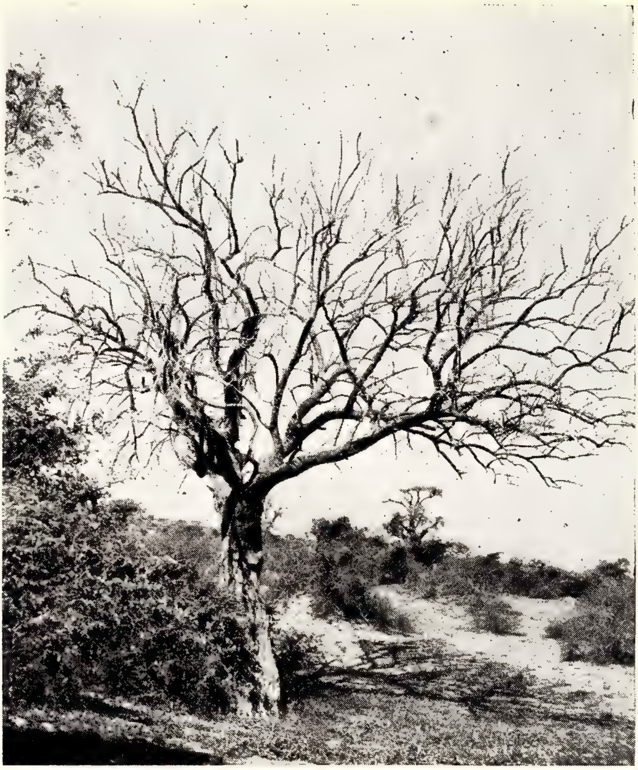
International: As stated previously the locust belt extends from India to west Africa; therefore, for ensuring the success of the anti-locust campaign as a whole international co-operation is essential. There is a convention between the Governments of India, Pakistan and Iran under which information regarding the locust situation is regularly exchanged, and, every year during a cycle the



The adult emerging after the final shedding of the skin

Photos *Authors*

A hopper-infested field of 'bajri' being dusted by hand-operated dusting machine



Tree totally defoliated by a swarm

Photos *Authors*

'Piper Cub' in spraying action

representatives of these countries meet, review the situation and discuss plans for action. Other interested countries are also invited to attend these conferences. During the conference held under this convention at New Delhi in 1950, it was decided to approach the F.A.O., for arranging from some international source, material assistance for fighting the locust menace. Accordingly, the F.A.O. convened a conference of experts from all countries at Rome in October, 1951. The main recommendations of this conference were that a Standing Committee should be appointed to assist the F.A.O. in the general co-ordination of the work in the entire locust belt, and the proper disposal of any material assistance which might be forthcoming. An advisory committee has been set up and one of us (H.S.P.) has been appointed as a member.

India: Since 1939, the Government of India is maintaining a permanent Locust Warning Organisation, which keeps a careful watch over the fluctuations of locust population in the desert outbreak areas. The organisation also collects information from the various States and countries and disseminates it to all concerned, by means of periodical bulletins and radio broadcasts. The organisation works under the control of the Director, Locust Control, and Plant Protection Adviser to the Government of India, Ministry of Food and Agriculture. During the swarming period this organisation is expanded and a control wing is added to it. The control work is carried out under the Anti-locust Co-ordination Scheme and the expenditure on actual control operations in the desert outbreak areas is shared by various beneficiary States. This scheme was started in 1942. The various States maintain their own organisations for intelligence and control in their cultivated areas. The Director, Locust Control in India, however, co-ordinates the work in the various States.

In the desert areas, technical assistance, labour, pesticides, etc., are provided from the Central Anti-locust Pool, but conducting the actual control operations is the duty of the revenue staff, assisted by all other departments, and under the general supervision of the central organisation. The Central and State organisations work in close co-operation. When locust breeding is heavy, normal revenue work is suspended to enable the staff to devote their wholetime attention to the anti-locust campaign. Wherever necessary, additional revenue staff is also appointed. The Ministries of Defence, States, and Railways & Communications also extend their full co-operation.

For control operations in the desert areas, the Central Anti-locust Organisation has about five dozen 4-wheel drive vehicles (which can cross the difficult sandy areas), over 2,000 hand-operated and 80 power-dusting machines, etc. Wireless sets are functioning at about a dozen strategic points, particularly near the Indo-Pakistan border. Similarly, States maintain equipment for the cultivated areas but, at a time of emergency, they can have more on loan from the Central Organisation.

The Central Organisation has employed aeroplanes (Catalinas, Ansons, Tigermoths, etc.) for locust reconnaissance. In 1951, three small planes ('Piper Cubs') were secured under President Truman's Four Point Programme to test the aerial method of locust control (Plate II).

CONTROL METHODS

Swarms: The control of swarms is ordinarily a difficult task because of their quick movements over extensive areas. When the swarms rest at night, they can be dusted by ground machinery. During April-June control even at night is generally not possible because on account of the prevailing high temperatures locusts are active and get disturbed when approached. During monsoon the temperature is lower and the locusts settle down longer for copulation and egg-laying, providing better chances for their control. Winter is particularly suitable for their destruction, because the locusts generally settle down early in the evening and resume flight next day by about 10 a.m. During the period of rest they are benumbed with cold and their destruction becomes easier.

Swarms can be destroyed by the following methods:

(i) Collecting locusts at cooler hours and burying them or beating them to death.

(ii) Burning them with flame throwers or local 'mashals'.

(iii) Baiting with sodium fluosilicate, BHC, etc.

(iv) Dusting with 10% BHC, particularly with power dusters. Hand dusters can also be used if a swarm is settled on the ground, crop or low bushes. In Rajasthan major parts of about half a dozen swarms and part of several others were thus destroyed during 1950 and 1951.

(v) Aerial spraying was tried in India in the Bikaner area during August, 1951, the insecticide used being a mixture of Aldrin in kerosene oil. In all, one dozen mature resting swarms were treated, covering a total area of 2,080 acres. As the swarms moved out of the sprayed area it was not possible to work out the percentage of mortality, but quite a number of dead and paralysed locusts were found in the sprayed area and in one case even upto 10 miles from the area of operation. In one case locusts from the sprayed area were collected and kept in a cage where 74% died within 48 hours.

For the control of a swarm, the time factor is very important, because their resting period is short. It is, therefore, essential for information about the settled swarms to be communicated immediately to the centres where the control equipment is located. The equipment must be rushed to the spot promptly because the operations have to be concluded by the morning, i.e. before the swarm takes wing. It is no use chasing the swarm after it has started on the move. It is desirable to have control equipment at several centres connected by a net work of wireless sets and each provided with a fleet of vehicles. The village organisations should thin out the swarms by beating, burning, etc. if control machinery is not available.

The views of Mr. O. B. Lean, U.K. entomologist who was in India during September 1951 and is at present in charge of anti-locust operations in East Africa, are interesting:

'It is not easy to exterminate a flying swarm. The world is seeking for a mode of attack but nothing really practical is yet available. It has been calculated that with an average settled swarm there are 300 tons of locust per square mile. A swarm may frequently cover 10 sq. miles. How far can hand collecting of locusts reduce these 3,000 tons? How much kerosene will be required to burn them? BHC dust is certainly highly effective but time is limited and a great number of machines is required to treat the whole area before the swarm moves on again. As speed of application is the main difficulty, perhaps aircraft provide the answer; but to kill our theoretical swarm some 60 tons of dust will be required and to spread this would require 300 sorties by small aircraft. They cannot fly at night and there may be only 2 hrs. in the morning before the locusts themselves fly off. Such are some of the difficulties. Aircraft may seem an obvious method of attacking locusts—adult swarms and hopper bands. I believe they will have a limited use, but much has yet to be done before their value is established. It is certainly encouraging that India is studying this particular problem. The Air Unit working in Bikaner is being used for a very practical experiment.'

Eggs: Destruction of locusts in the egg stage is not profitable as it is not possible to destroy all the eggs in any area. Therefore control operations in these areas have necessarily to be repeated when the hoppers emerge. The egg-laid areas should, however, be marked out and preparations for control made in advance, so that hoppers can be destroyed in early stages.

Some synthetic insecticides have prolonged residual effect. It is under trial, if any of them (possibly Aldrin) can be used as a spray on egg-laid areas, anticipating the emergence of hoppers.

Hoppers: The hopper stage is the most vulnerable in the life history of the locust. In fact, effective control is generally possible in this stage only. Although the hopper period lasts for about four to six weeks, control measures are most effective and easier against the younger hoppers. The following are the control methods:

(i) *Trenching*: Trenches are dug across the front of marching hopper bands, the width and length of the trench varying according to the stage of the hoppers. For young hoppers, a trench 18 inches deep and 12 inches wide is enough. The trenches are generally supplemented by tin sheet barriers which are placed at an angle oblique to the direction of the drive.

(ii) *Burning*: Hoppers congregated on bushes are burnt, flame-throwers being used wherever available. The 'mashal' or flaming torch is a good substitute. A barrier of tin sheets may be erected round the bush before it is set on fire.

(iii) *Poison baiting*: Poison baiting is another method which is extensively used in some of the countries. The bait consists of bran and poison such as BHC, sodium arsenite or sodium fluosilicate. The main limiting factors in India are the high cost and inadequate supply of bran and difficulty in its transportation.

(iv) *Poison dusting and spraying*: The poison dust used most commonly is benzene hexachloride (BHC) (Plate I). For young hoppers about 2.5% strength is enough but it has to be increased upto 7% and even 10% for hoppers of advanced stages and freshly fledged adults. The insecticides DNOC and Aldrin are also in extensive use against grasshoppers and locusts in some countries. Spraying Aldrin against hoppers from an aeroplane was tried in 1951, but it did not prove economical as a routine method of control.

Biological Control: Several birds eat locusts. Of these, crows, kites and tiliars (Rosy Starlings) have been particularly observed destroying locust adults and hoppers. The Rosy Starling (*Pastor roseus*) is the most important enemy. It is migratory bird and is found in very large numbers during the locust season. It should, therefore, be protected. In fact, in some States its shooting is already prohibited. The locust is also eaten by reptiles. Among mammals, it is destroyed by foxes, bats, etc., and large numbers of locusts are collected by humans for consumption, particularly in Pakistan, Persia, Arabia, etc. Fried locusts are considered a very delicious dish in some of these countries. Aslid flies and mantis also feed upon young hoppers. Some mites also attack locusts. Other biological enemies of locusts, such as bacterial and fungal diseases, do not so far offer any practical solution of the locust problem.

FISHERIES RESEARCH IN INDIA[1]

BY

N. Kesava Panikkar

Chief Research Officer,

Central Marine Fisheries Research Station, Mandapam, South India

Part I

(*With eight plates*).

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1. The Problems

The problems of fisheries research in India could be formulated in the following 15-point programme:—

1. A qualitative and quantitative appraisal of our aquatic food resources and the principal species contributing to them.
2. Acquisition of full biological knowledge of those species and factors influencing their abundance and availability for fishing.
3. Application of that knowledge to the management of the fishing programme so that a steady annual yield may be assured.
4. Exploration and charting of fishing grounds in the sea in relation to time and space.
5. Experimental fishing to select types of craft and gear suitable for mechanization so as to increase the range of sea fishing and catch per unit of effort.
6. Investigations to select species which could be cultivated as food, and habitats which could be developed for that purpose taking full advantage of geographical and climatic features.
7. Perfection of field practices which would lead to the development of marine and coastal fish farming.
8. Expansion of fish seed resources as the basis for the extension of fish culture operations.

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[1] The views expressed in this paper are purely the personal opinions of the author and should not be taken as the official views of the organization to which he belongs.

9. Development of improved methods for growing fish in village ponds as an essential contribution to rural economy.
10. Protection of fishery wealth from being wiped out by multi-purpose projects and industrialization.
11. Perfection of methods of handling fish and fish products to reduce wastage by deterioration and to ensure their reaching the consumer in a good condition at a low price.
12. Improvements in methods of processing to utilize the surplus, and the introduction of new and acceptable methods for utilizing surplus landings.
13. Technological improvements in the manufacture of fish oil and other fishery by-products which are at present not or only inadequately utilized.
14. Researches on consumer preferences, price structure, commercial organization and other factors influencing the industry, and on the socio-economic fabric on which the industry is based.
15. Discovery of new aquatic food resources and the techniques for their utilization.

2. Introduction and Retrospect

In the following account an attempt is made to give a brief outline of the various aspects of work above enumerated; what has been done and what remains to be done. At the very outset, it may be conceded that considering the magnitude of the problems, the size of the country and the material value of the resources concerned, the efforts expended towards research is small and work is in the very early stages of fact finding. In many other countries where fishery wealth ranks high, well-developed research organizations have grown gradually for a number of years and work has been steadily carried out, which has taken them past the introductory phases, enabling them to understand their problems and to apply scientific results for the adequate management and utilization of their fisheries. Much of the work which they now do deals with aspects closely related to the actual management of the fishery and fishing industry. On the other hand, in our country little or no attention has been paid to this subject all these years, except within the last five years. A large amount of preliminary investigations remain to be covered before we are in a position even to evaluate our various problems. The gap between scientific investigations on the one hand and obtaining results of immediate practical application to the fishing industry on the other is unfortunately large, and achievements in the field of research judged by short-term standards are often unimpressive. Mistakes have been made in considering fisheries research as a matter purely for Provincial or regional action subservient to the local problems of development. A greater mistake was to consider fisheries research as a commercial investment which should bring direct revenues to administrations in complete disregard of the role it undoubtedly plays in the increase of food supplies, improvements in nutritional standards and attendant benefits to the public health and physical well-being of our people, and the raising of the standard of life of a very considerable section of our population who are directly engaged in fishing operations and trade.[1] As pointed out by Sewell, Fisheries Research should be regarded as a social service and not as a business enterprise although as work progresses it will be the basis for the expansion of the industry in fish which is already an important article of commerce both in the fresh state and as cured fish for inter-Statal and export trade.[2]

Interest in fish has been evinced from ancient times in India as found from references in Kautilya's *Arthashara* (*c.* 300 B.C.) and some of the Pillar Edicts of Asoka (246 B.C.) (Hora, 1948, 1950). The ancient Hindus had also made comments on the form and behaviour of fishes in relation to their environment and modes of locomotion. The possibility that taboos introduced by Asoka for the consumption of fish during certain phases of the month were based on the knowledge of the breeding habits of fishes like Carps has been indicated by Hora (1950). These views as well as the chronology of some of the earlier texts are controversial, but there seems to be enough evidence to show that the role of fish as food for the people was fully realized. Fishery science in the modern sense has, however, not a long history in this country. It is necessary to draw a distinction between *research on fish* and *fisheries research*, the latter being a modern development of the study of fish stocks in relation to their yield. If this interpretation is taken, fisheries research has hardly made a beginning in this country, although we have a considerable amount of information on the fishes which contribute to our fisheries. Among the earlier contributions on the fishes of India which deserve mention are the account of the fishes of the Ganges by Hamilton Buchanan (1822) and the comprehensive work on Fishes of India by Francis Day (1876-78). These two monumental contributions may be said to form the basis for all ichthyological work in this country and even to-day the two volumes on Fishes in the Fauna of British India Series by Francis Day (1889) constitute the only standard work. During the past fifty years, substantial additions to our knowledge of Indian fishes have been made through the efforts of many investigators, the most outstanding among them being Hora. Till about 1930 the progress achieved was largely in the fields of taxonomy and geographical distribution, but with the growth of departments of zoology attached to various Universities, noteworthy among them being Madras and Calcutta, increasing attention began to be paid to the study of life histories and habits of both freshwater and saltwater species. These studies concerned more with the zoological aspects rather than with fishes as contributing to fisheries. Similarly, a large volume of information has been collected by the many naturalists and sportsmen who have visited various parts of India. It may, however, be mentioned that subsequent to Day, the basic work relating to fisheries was until 1930 carried out at the Zoological

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[1] The number of active adult fishermen alone is estimated at 500,000 while the total fishing population is estimated at 1,600,000. Including those who no longer do fishing, over eight million people belong to fishing communities.

[2] About 43 per cent of the total production is consumed as fresh fish, the remainder being cured. Exports include about 30,000 tons of cured fish valued at about 300 lakhs of rupees and 3,000 tons of fish manure valued at Rs. 3 lakhs (Pre-partition figures).

Survey of India which still has the largest authentically named collection of fishes in the East.

The oldest established Department of Fisheries in India is in the State of Madras, where, thanks to the efforts of the late Sir Frederick Nicholson, the problems of fisheries received attention even during the last century leading to the formation of the Department in 1905. Researches on important marine fish like sardines and the flying-fish, the pearl oyster and a few of the freshwater fishes were carried out by the scientists of the Madras Government, notably Hornell, and continued by Raj and Devanesan. A real impetus was also given to fisheries and marine research in general by the publication of the Reports on the Pearl Oyster Fisheries of Ceylon edited by Sir William Herdman (1903–6) and the starting of the Marine Experimental Station at Ennore (1908), the Madras Aquarium (1909) and the Field Collecting Station at Krusadai (1928) by the Madras Government. Similarly, the opening of the West Hill Biological Station at Calicut (1921) where much of the early research on sardines has been done, was a pioneering effort in the study of Indian marine fishery problems initiated by Hornell. In Bombay with the opening of the State Fisheries Department in 1933, work relating to a preliminary assessment of the resources was carried out and steps taken for increased utilization of marine fish by mechanized transport along the coast. In Bengal, interest in fisheries, although begun towards the end of the last century, suffered neglect in the later years and no substantial progress was made until its revival within recent times (1941). Travancore started the Department in 1916 and work on a small scale has been in progress there ever since. These are the only centres which have contributed to the subject, although in recent years, smaller fishery stations have been opened in Orissa, U.P., Baroda and Mysore. Considerable work on freshwater fisheries in the Punjab and exploratory work on marine fisheries in Sind was also carried out by those provinces of pre-partitioned India.

The next phase in the progress of fisheries research is the interest taken by the Indian Council of Agricultural Research,[1] which subsidized definite schemes of fishery work at various centres. The following is a list of the schemes subsidized by the Indian Council of Agricultural Research :—

1. Life-history, bionomics and development of Freshwater Fishes of Bengal—Calcutta University, 1936–46.
2. Rural Pisciculture—Madras Province, 1942–51.
3. Processing of Fish—Government of Baroda, 1943–45.
4. Improvement of Preserved Fish Industry in Bengal, 1944–46.
5. Fish Eggs & Larvae of Madras Plankton—Madras University, 1944–47.
6. Do Bombay Waters—Bombay University, 1944–47.
7. Manufacture of semi-dried prawns—Madras Government, 1945–48.
8. Bionomics of Indian Migratory Fishes—Bengal Government, 1946–48.

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[1] Formerly known as the Imperial Council of Agricultural Research.

9. Experimentation on the Barn type of Dehydration plant for preservation of fish—Orissa Government, 1945–47.
10. Biology of Marine Prawns—Madras University, 1947–49.
11. Award of scholarships for fishery research—Calcutta University.

Although some very commendable individual efforts have been made in the progress of these schemes by the respective groups of investigators, the results achieved have not been impressive owing to lack of facilities and funds to take up work on any adequate scale and the transitoriness of the schemes which made it impossible to maintain continued effort. These schemes were mainly sponsored by individual scientists, with the backing of the organizations to which they belonged, like the Universities or the Provincial Departments of Fisheries, who did real service in coming forward to take up fisheries research at a time when no such work was being carried out. They were thereby able to train young scientists who subsequently were available for recruitment to the staff of the fishery research stations when they were established, along with the scholars chosen for training in fisheries in the U.K. and the U.S.A. under the foreign scholarships schemes of the Central Government. The Indian Council of Agricultural Research also had a sub-committee to deal with fisheries which did much exploratory work on the establishment of a Fisheries Research Institute for the country.

When the Indian Constitution of 1935 came into force, Fisheries was definitely considered as a provincial subject in the same manner as Agriculture. This transfer of authority to the provincial sphere resulted in what may be called unco-ordinated development of fisheries activities in the various States of India. While some States like Madras forged ahead and implemented several schemes for the development of fisheries both marine and inland, many states although rich in potential resources hardly paid any attention to this source of food. The reasons for apathy were also psychological for, with the partial exception of Bengal, influential and progressive communities in the various provinces were generally not inclined to accept fish as an important item in the food requirements of the people.[1] As a result of the last war and with the increasing food shortage in the country brought very poignantly before the public mind by the Bengal Famine of 1943, the question of development of fisheries on an all-India basis received the earnest attention of the Central and State Governments. The Government of India decided that some central agency to advise and coordinate development in the various sectors of fisheries and fishing industry was necessary if this valuable source of food was to be utilized and its production augmented. Attached to the then Ministry of Agriculture was created a section dealing with fisheries headed by Baini Prashad[2] who was then Director of the Zoological Survey of India. It is worth while mentioning here that, in the organization of a central machinery for fisheries work in the country on an all-India basis and in the formulation and implementation of the Central Government schemes, the work of Prashad will long be recognized as a notable contribution. A similar contribution to place fisheries in the scientific programme of the country and to create much needed public interest on the subject, more especially on fish culture, was made by Hora[1] who wrote extensively on the various aspects of fishery research and development.

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[1] Mahatma Gandhi's advocacy of the subject in February 1946 did much to improve this background.

[2] Prashad had H. S. Rao as his Deputy, the present author as Officer on Special Duty for Fisheries Research and D. R. Bhatia as Asst. Adviser. H. S. Rao took charge of the Marine Fisheries Research Station early in 1947 and was succeeded by B. N. Chopra as Deputy. With the retirement of Prashad and Rao Chopra succeeded as Adviser at the Ministry and the author as Chief of the Marine Station.

Apart from research on fish and fisheries, an essential line of exploratory activity lay in experimental operations of new types of fishing in Indian waters. The craft and gear employed by our people remain as they have been for centuries past, both frail and primitive. It is not suggested that they are not efficient, but, on the other hand, considering the material available, the cost and mode of operation, it is impossible to improve on them for the limited use to which they are put. Their greatest drawback lies in their dependence on wind power for propulsion, making them available for use only within a narrow stretch of the coastline, hardly more than five to ten miles off the shore and, in many instances, much less within five miles. They are likewise unable to withstand the fury of the monsoon winds, which limits fishing to certain seasons only. The inadequacy of this craft for large-scale operation lies in its inability to use any large trawl or seine net or in fact any large net which would raise the catch per head to any appreciable extent. Large catches are obtained during favourable seasons, but it is seldom that these can be landed and utilized on the shore before they deteriorate. In spite of their innate efficiency, they are not enough for any large-scale exploitation of the sea, if any substantial progress in fish landings is aimed at.

Realizing this the Governments of Bengal, Bombay and Madras at different times tried to introduce mechanised fishing by experimental operations carried out by trawlers. 'Golden Crown' in Calcutta (1908–9), 'William Carrick' in Bombay (1921–22) and 'Lady Goschen' in Madras (1927–29) carried out such exploratory fishing in waters of the three Provinces respectively. Unfortunately, the employment of trawlers for these experimental operations was based on the presumption that the tropical-fisheries would show the same pattern as those of the colder seas where the large majority of exploitable species occur at considerable depths. It was not then realized that in tropical seas where problems of productivity and marine phenomena occur in a different manner, the major fisheries are either pelagic or mid-pelagic. Owing to this fundamental error and the numerous difficulties connected with the introduction of mechanized gear in a country where no industrialization of any type had taken place, these operations were not marked with any notable success. In spite of these difficulties, the catches were moderately good, but sooner or later, all these operations were given up by the respective Governments that undertook the ventures, as they were commercially unsuccessful.

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[1] Hora was also Honorary Chief of the Inland Fisheries Station for a short period after its inception, but was succeeded by **T. J.** Job who remained as chief of the Inland Station until December 1951.

In 1946, the Central Ministry of Agriculture decided to start fisheries research on an all-India basis together with research operations in mechanized fishing. The advice of foreign experts was obtained, notable among them being Col. R B. Seymour Sewell, F.R.S., who drew up a memorandum for the establishment of a Fisheries Research Institute which he envisaged in the form of two marine stations, one for the East Coast of India at Mandapam and one for the West Coast of India at Karachi, one inland fisheries station at Khulna or Calcutta with a mobile estuarine unit and a power fishing operational unit at Bombay, together with a technological institute at Calicut. These schemes had to be considerably modified owing to the partition of the country and subsequent developments resulting in the Government's decision to have the Marine Fisheries Research Station at Mandapam and the Inland Fisheries Research Station at Pulta near Calcutta. One of the trawlers which became surplus to the requirements of the Indian Navy, H.M.S. 'Berar' was taken over by the Ministry and converted for fishing operations, thus beginning pilot fishing operations at Bombay. By the end of 1947, all these stations had taken shape and by the time our new Constitution had been adopted which makes research and fishing in off-shore waters a definite central responsibility as against the provincial sphere of development and regional research, the nucleus of research organizations to deal with at least the major aspects of Indian fisheries has been laid. A brief account of the three central institutions may not here be out of place.

3. The Research Institutions

(a) THE CENTRAL MARINE FISHERIES RESEARCH STATION

The Central Marine Fisheries Research Station was started in February 1947 for handling marine fisheries research on an all-India basis with temporary headquarters in the Biological Laboratories of the Madras University where the staff remained till September 1949 when the Station was shifted to its permanent headquarters at Mandapam. Buildings originally put up as a naval hospital by the Defence Department during World War II were acquired and converted into laboratories and temporary residential accommodation for the staff. Subsequently, an aquarium was built, fittings to the laboratories carried out and an effective means of running sea-water for keeping marine organisms has been worked out and its installation is nearly complete. A capital expenditure of 6½ lakhs of rupees has been incurred on the Station and about a hundred acres of land around has been acquired for expansion and for putting up permanent residential buildings. In addition to the headquarters Station, there is a subsidiary Research Station at Kozhikode to deal with the special fisheries problems of the West Coast of India, a research unit at Karwar in the Bombay State to deal with the mackerel fishery, and another unit at Narakkal in Travancore-Cochin to deal with the prawn fisheries and prawn farming operations. It is also proposed to set up very shortly a research unit at Bombay for carrying out investigations on off-shore fisheries and another at Ennore (near Madras) for handling studies on edible Mollusca. In order to collect fishery data from the large coast-line of India, fishery survey assistants have been posted at twelve centres representative of the various divisions of our coastline extending from Kathiawar to West Bengal. The data gathered by them are regularly sent to the headquarters where they are analysed and for the first time, a machinery for the collection of all-India marine fishery statistics has been developed and put into execution.

The work of the institution is broadly divided into four categories, Fishery Survey, Fishery Biology, Marine Biology and General Physiology. Fishery Survey aims at assessing the marine fishery resources of the country, computing fish landings and to see if the marine fisheries in general are under or over utilized. The studies relating to Fishery Biology deal with the fish stocks, special habits, distribution, life-histories and such aspects of fish life as have intimate bearing on fisheries problems. The major fisheries of India like the Sardines, the Mackerel, the Sharks and other less known categories of fishes are all investigated in detail in an attempt to understand the causes governing their abundance, and the efficiency with which the fish are caught and utilized. Subsidiary fishery resources like the prawns, the oysters, clams, etc., are also receiving close attention. Sea weeds which occur in considerable abundance in the sea and form a valuable raw material for the production of agar and other industrial products are being investigated in detail to determine the extent of the resources. The third important category of investigations come within the field of Marine Biology dealing with the factors connected with the abundance of smaller forms of plant and animal life which ultimately form the food of fish. This is also correlated with studies on the chemistry of sea-water with a view to understanding seasonal changes in the occurrence of fertilizing substances in the sea. Bacteriology of sea-water and fish products is also investigated with a view to arriving at enforceable standards in the handling of fish products. The physiology of fish and other commercially important forms of marine life are studied with a view to selecting suitable types that would be ideal for large-scale culture in coastal waters which could be developed into marine fish farms. The institution maintains a good library and a reference collection of correctly determined marine fishes.

(*b*) THE CENTRAL INLAND FISHERIES RESEARCH STATION

The Central Inland Fisheries Research Station at Barrackpore near Calcutta handles investigations pertaining to freshwater and estuarine fisheries of India. The Station was started in March 1947 and is located at Pulta (Barrackpore) and it has a sub-station at Cuttack in Orissa. The comprehensive programme of freshwater fishery research which is before the Research Station, is detailed below:—

1. The hydro-biology of fisheries of estuaries, brackish-water and lakes;
2. Studies on Hilsa, the major carps, mullets and prawns of inland waters;
3. Investigations on the micro- and macro-fauna and flora associated with tank and pond life;
4. Pond culture experiments on the development, growth and food of the major carps and other fresh water food fishes under varying conditions;
5. Study of the extent of freshwater fish seed resources;

6. Investigation regarding fish migration and influence of dams and weirs on fish life ;
7. Study of the pollution effect of industrial and municipal wastes ;
8. Investigation on the use of sewage in manuring fisheries ;
9. Substratal variations in the waters and their influence on the fish life ; and
10. Comparative study of the fishing methods in different types of inland waters.

The work of the Station is broadly divided into three main sections, Estuarine Fisheries, Pond Culture, and Riverine and Lacustrine Fisheries. The problems under investigation at the Station include rearing and transport of freshwater fish-seed, study of food, growth, maturity, and breeding of freshwater and estuarine fishes of commercial importance. Special fisheries like Hilsa, and mullets are being investigated in detail and problems of hydrobiology in relation to the freshwater and estuarine fisheries of the Gangetic delta are being studied. Pond cultural practices and investigations to reduce the mortality of fish-seed are receiving urgent attention owing to the immediate value which such investigations have in the development of freshwater fisheries. The effect dams have on riverine fisheries is being closely studied owing to the various river valley schemes which are being actively pursued in the States of Bengal and Bihar and the probable effect which they will have on the fisheries of the entire region.

(*c*) THE DEEP-SEA FISHING STATION

The Deep-Sea Fishing Station was started in Bombay in 1946. As suitable fishing vessels were in very short supply in India and abroad at that time, fishing operations were started in January 1948 with the converted Basset Steam Trawler ' Berar ', under the name ' Meena '. The vessel was in commission for 513 days, but on account of several difficulties partly due to congestion in the Bombay Port, it was out at sea only for 212 days. In addition to doing charting and other exploratory work mostly in waters north-north-west of Bombay, she was able to land 4,400 maunds of fish, giving a catch of 20 maunds per day's absence from port. S.T. ' Meena ' was a single-screw vessel, 152′–5″ in length and with a net registered tonnage of 159·85 tons. An ice-making and cold storage plant was installed on the ship. As the maintenance and operation costs of this large coal burning vessel were unduly high, she was decommissioned in June, 1949. The work that S.T. ' Meena ' was doing is being continued with two Dutch motor cutters, M.T. ' Ashok ' and M.T. ' Pratap ' (of an overall length of 83′–4″ and net registered tonnage of 23·44 tons each) and two Reekie boats M F.V. ' Bumili ' and M.F.V. ' Champa ' (each being 50′ long and having a net registered tonnage of 10·01 tons). Both the cutters have been commercially more successful than the S.T. ' Meena '. Cutters ' Sagarika ' and ' Baruna ' of the West Bengal Government began operating from Calcutta in 1951 with considerable success. Recently a Japanese trawler ' Tayo Maru 17 ' has been conducting offshore fishing from Bombay with the permission of the Government of India. Commercially this vessel has been very successful and has landed catches on a scale larger than any mechanized vessel so far operated in India. An account of the working of these vessels and analysis of the catches will be given under the section on Power Fishing.

(*d*) INSTITUTIONS OF STATE GOVERNMENTS & UNIVERSITIES

In addition to the three Central Institutes dealt with above, there are centres of fishery research maintained by some of the State Governments and Universities where work on biological problems related to fisheries continue to be carried out. In 1937 the University of Travancore created a Chair for Marine Biology and Fisheries and an aquarium was completed and opened in 1940. Some progress has been achieved there in preliminary studies pertaining to problems of that area. The Taraporevala Aquarium in Bombay which was set up by the Bombay Government aided by a private benefaction was completed and opened in May 1951 as an adjunct to the Department of Fisheries, Bombay. This fine aquarium which is now attracting large numbers of visitors will no doubt go a long way in creating public interest in studies on fishes. It is regrettable that the Madras Aquarium, one of the oldest of such institutions in the East, which was dismantled during the Second World War has not yet been restored. Among other research centres maintained by State Governments reference has already been made to the Biological Station at West Hill and the Field Centres at Krusadai and Ennore. In addition, the Madras State Government maintains a Pearl and Chank Unit at Tuticorin, a Fishery Technological Station at Calicut and a Hydrobiological Unit at Madras to deal with problems of freshwater fisheries. Orissa State has opened a research station on the banks of the Chilka Lake at Balugaon for the study of the fisheries of the lake. The State of West Bengal has a small technological unit attached to the Department of Fisheries, and exploratory power fishing and investigation of the Bay of Bengal have been begun with two Danish cutters. Similar freshwater fisheries centres have been opened by the States of Uttar Pradesh and Bihar. Baroda had plans to open a Biological Station at Port Okha, but owing to the integration of the State with Bombay, the project is probably being re-examined and eventually marine stations may be opened at Ratnagiri and Okha. Among the Universities, Madras has since 1933 carried out a considerable amount of marine biological work which has been so essential to providing a background for fisheries investigations and training workers, while a similar position in freshwater fisheries work has been maintained by the University of Calcutta.

A great handicap in marine fisheries work in India at present is the absence of any fisheries research vessel. Work has necessarily to be restricted to the facilities offered by the commercial catches brought by the indigenous vessels. The recent ventures in power fishing have given added facilities for investigations, but it would obviously be difficult to combine the needs of research with purely commercial operations. The Government of India have already plans for the acquisition of a research vessel for marine fisheries investigations, and it is hoped that exploratory surveys and marine investigations could be soon started in our off-shore waters in the same manner as experimental fishing started from Bombay.

4. SURVEY OF RESOURCES AND STATISTICS

(*a*) STATISTICS OF PRODUCTION

For any programme of improvement of the Fisheries, it is essential to have a clear idea of the resources. Owing to the very diffuse nature of this industry in our country, there are many practical difficulties in obtaining accurate information. Reliable statistics of production are wanting. Based on the survey carried out by the Agricultural Marketing Department during 1941, the following figures were arrived at for undivided India. (*vide* Agri. Marketing Reports).

	Quantity in lakhs of maunds.	Metric tons.	Value in lakhs of rupees.
Sea fish (including estuarine fish) ...	116·7	4,35,909	302·7
Freshwater fish (excluding that caught by non-professional fishermen)	62·6	2,33,829	742·3
Total ...	179·3	6,69,738	1,045·0

The generally accepted figures for partitioned India based on 1948 figures of the Marketing Department are :—

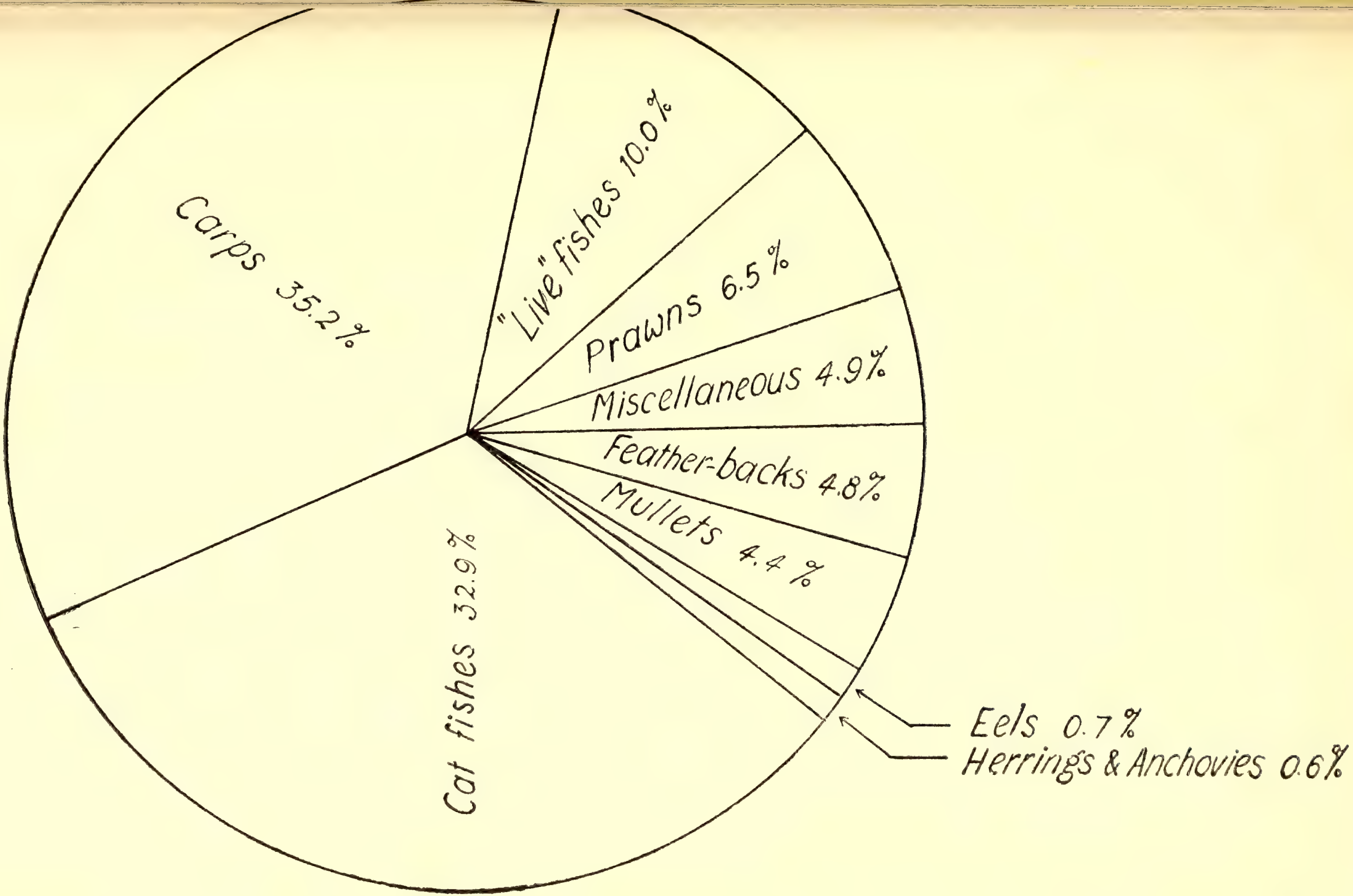
	Quantity in lakhs of maunds.	Metric tons.	Value in lakhs of rupees.
Sea fish (including estuarine fish) ...	100·9	3,76,891	868
Freshwater fish	41·2	1,53,894	927
Total ...	142·1	5,30,785	1,795

These figures give only a very rough idea of the total production and value. The sea fish comprise some 70 per cent of the total production, but owing to the fact that a large fraction is converted into manure, the average value of sea fish is considerably less than what it would be if adequate shore facilities existed to utilize the surplus production as fresh fish or as processed food. Although the total production is small, the freshwater fish contribute to a larger share of the total value owing to the fact that the bulk of it is sold fresh to the consumers over areas scattered throughout the country. This is the reason why freshwater fisheries have a great importance in the development of village food resources in a stable rural economy as will be indicated in a subsequent section. It is also obvious that any appreciably large-scale increase in production is possible only from the marine resources, because, it is here that unexploited areas remain to be developed. Similarly it has been computed that if better use is made of sea fish instead of allowing a good fraction of it to be cured or converted into manure the value of sea fisheries would be about thrice the present value, a portion of which could be advantageously transferred to the consumer to make fish less costly to him than at present.

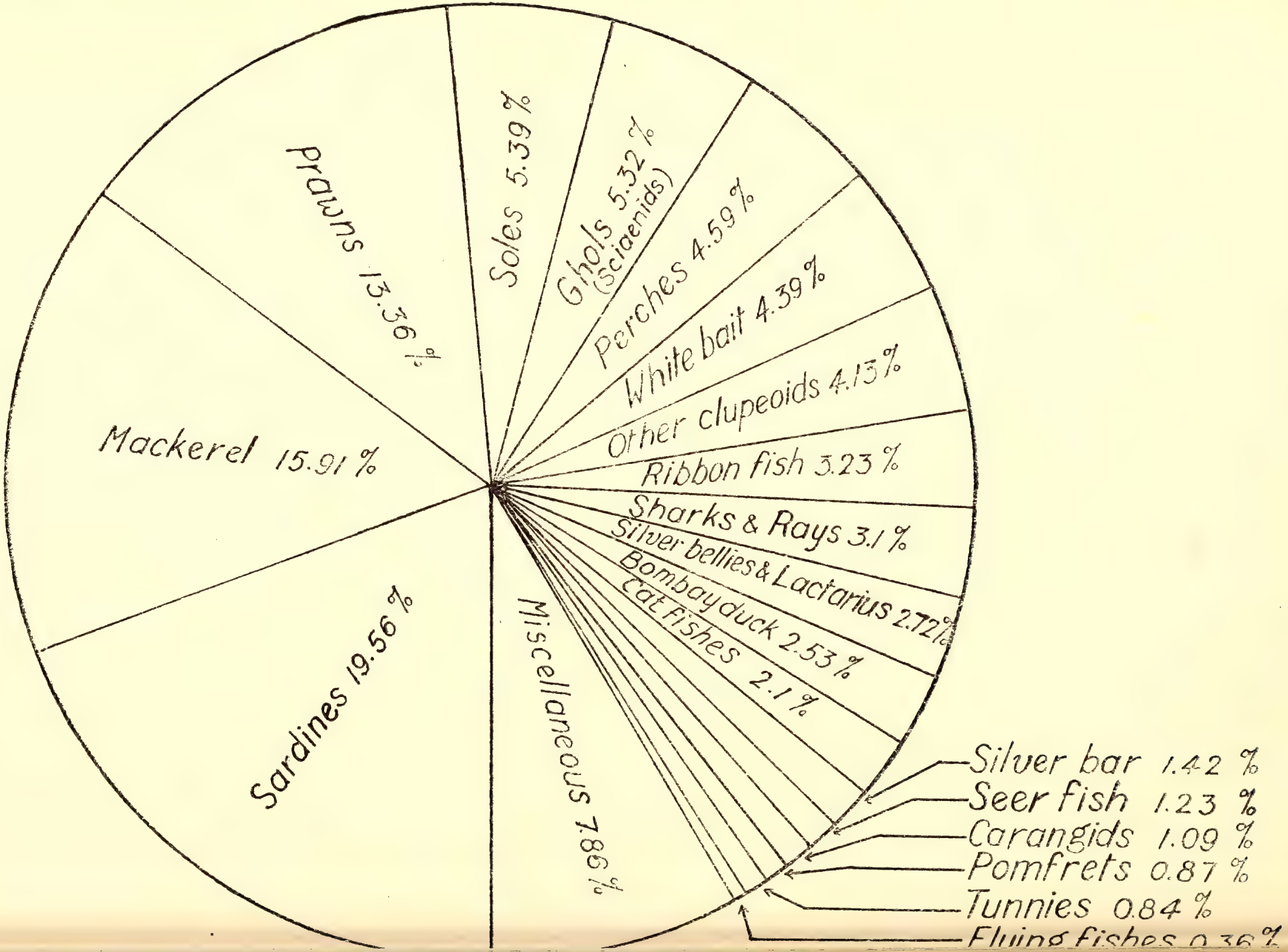
It is necessary to indicate here that we have no adequate machinery for the collection of fishery statistics. The difficulties of obtaining accurate fishery statistics, both as regards landings and disposal, are immense. Further, the scale of subsistence operations is always a problem to estimate. Any organization which aims at perfection should take into account the fact that there is no proper registration of craft and gear; the fishermen are illiterate and owing to the fear of taxation are by no means willing to give correct figures even if their cooperation is assured except under their own voluntary effort. Total enumeration would require an army of workers to deal with the fishing operations carried out throughout the country by the most infinitely varied type of fishing boats and nets and such an undertaking would obviously be expensive. Until recently no machinery for the collection of statistics existed. Some of the State Governments, notably Madras and Bombay, were obtaining figures for the total landings of fishes in the places where the coastal fish curing yards existed. But these figures were by no means complete and with the abolition of salt duty, which resulted in many fishermen not utilizing the services of Government fish curing yards, this machinery has practically broken down. With the introduction of subsidized issue of salt, the value of fish curing yards as an agency for statistics will again prove useful, but only a part of the production will be covered and that only of marine fisheries of Madras, Travancore-Cochin and Bombay States.

Realizing the importance of the marine fishery statistics in any organized programme of marine fishery research in the country, the Central Marine Fisheries Research Station has paid attention to this aspect even from its inception. A preliminary survey of the Indian coast was carried out and the entire coastline was divided into twelve zones, each zone being placed in charge of a survey investigator. Centres for observations and for enumeration of landings were chosen and a multistage random sampling method perfected for the collection of data based on which the total landings of the whole zone were computed. The observations made involved both a quantitative and qualitative assessment of the catches so as to develop the biological programme on the basis of the relative abundance of the various commercial species. As work progresses the centres where the survey investigators work are expected to serve as regular biological observatories for the study of commercial species in addition to their value as centres for the collection of statistics.

At present this is the only machinery in existence in India for the collection and coordination of Indian fishery statistics. In 1946 when this programme of survey was drawn up it was hoped that the State Governments would likewise develop survey organizations and the Centre would primarily deal with the methodology and coordination of the all-India statistics. Progress in this direction has not been achieved although it is hoped that with the increasing consciousness regarding the value of accurate statistics, some stable all-India machinery will be perfected. The Indian Council of Agricultural Research has already carried out some small-scale pilot investigations for evolving suitable techniques.



Principal Groups of Freshwater Fishes of India. After data in Marketing Report of Fish in India.


Prawns 13.36 %
Soles 5.39 %
Ghols 5.32 % (Sciaenids)
Perches 4.59 %
White bait 4.39 %
Other clupeoids 4.13 %
Ribbon fish 3.23 %
Sharks & Rays 3.1 %
Silver bellies & Lactarius 2.72 %
Bombay duck 2.53 %
Cat fishes 2.1 %
Silver bar 1.42 %
Seer fish 1.23 %
Carangids 1.09 %
Pomfrets 0.87 %
Tunnies 0.84 %
Flying fishes 0.36 %
Miscellaneous 7.86 %
Sardines 19.56 %
Mackerel 15.91 %

As regards the collection of statistics of freshwater fisheries there are several regional problems and hence they can only be tackled on a regional basis where the only agency which may be utilized lies in the State fishery departments.

The diagrams on Plates I and II show the various categories of marine and freshwater fishes of India and their relation to total production. Table I shows production by zones.

TABLE I

Table showing total landings of marine fish in India during 1949 and 1950

(Based on data at the Central Marine Fisheries Research Station.)

		In Metric Tons		
		1949[1]	1950	
1.	West Bengal and Orissa (part)	18,842	15,686	
2.	Andhra Coast (from south of Gopalpur to north of Visakhapatnam)	54,273	40,468	
3.	Andhra Coast (from Visakhapatnam to Masulipatam)	24,426	41,237	
4.	Andhra Coast (south of Masulipatam to north of Pulicat Lake)	1,308	969	
5.	Coromandel Coast (Pulicat Lake to Cuddalore)	12,685	30,284	
6.	Coromandel Coast (south of Cuddalore to Devipatanam)	11,850	9,652	
7.	Palk Bay and Gulf of Mannar (south of Devipatanam to north of Cape Comorin) ...	2,600	4,030	
8.	Travancore-Cochin and South Malabar (Cape Comorin to Ponnani R.)	48,659	93,600	
9.	Malabar and South Kanara (north of Ponnani R. to Mangalore)	85,512	1,66,321	
10.	Kanara, Karwar and Konkan Coast (north of Mangalore to south of Ratnagiri)	72,840	40,426	
11.	Bombay and Gujarat (Ratnagiri to Broach) ...	48,447	1,17,712	
12.	Kathiawar Coast (north of Broach)	...	...	Data not available
	Total ...	3,81,442	5,60,385	

(*b*) SURVEY OF FISHERY RESOURCES[2]

(i) Freshwater Fisheries:

The biogeographical and ecological conditions against which the fishery resources have to be examined may here be indicated. It is obvious that freshwater fisheries would flourish only in areas where large quantities of water are available either from rain or rivers. The river systems of India provide the backbone of freshwater fisheries because apart from the extensive riverine fisheries themselves, the rivers alone provide the means of providing water to many other culturable waters and also form the source from which sufficient spawn for cultural purposes could be obtained. The great freshwater basins of India are (1) the Ganga System stretched across the Indo-Gangetic plain and composed of the tributaries of the Ganga ; (2) the East Coast system comprising principally the Mahanadi, the Godavari, Krishna and Kaveri; (3) The West Coast system covering the narrow strip of land between the Western Ghats and the Arabian Sea which enlarges in the northern part to cover the Narbada and Tapti rivers ; (4) the Brahmaputra system covering Assam; and finally (5) the Indus system which is now of negligible proportions in India after partition.

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[1] 1949 figures are probably incomplete.

[2] For a detailed survey of the resources, *vide* Handbook of Indian Fisheries edited by B. N. Chopra, Ministry of Agriculture, Government of India, 1951.

Water system	*Catchment area lakhs of sq. miles*	*Length of rivers*	*Rainfall*		*Annual run-off Million/Acre/ Feet.*
		Miles	*Range*	*Average*	
Ganga system ...	3·75	5,000	25″ – 77″	43″	20″ 397
East Coast system ...	4·70	6,400	28·8″ – 61·5″	42·77″	135″ 334
West Coast system ...	1·90	2,100	15″ –115″	48″	25″ 252
Brahmaputra system ...	2·00	2,500	40″ – 83″	48″	30″ 310

It will be obvious from the above that the Ganga system constitutes the most important region from the freshwater fisheries point of view and covers the States of West Bengal, Bihar, Uttar Pradesh and a portion of Madhya Bharat. The rivers also support several perennial and seasonal jeels and ponds and a wide variety of freshwater habitats at varying elevations and having different temperatures and harbouring a rich fish fauna of game fishes, loaches, culturable carps and prawns. The second in importance is the more diffuse East Coast river system which has rich carp fisheries in the northern sector but gives place to the more miscellaneous assemblage of warm water fishes in most other parts. The carps and game fishes and various other freshwater groups are also noteworthy in the other systems. Freshwater lakes in India are few but mention may be made of the Kumaon lakes in Uttar Pradesh which have valuable Mahseer fisheries and the Mettur lake in the south, developed artificially by the construction of the Mettur Dam, which is now yielding an extremely rich carp fishery.

The freshwater fishery resources of India comprise (1) the major carps, (2) the catfishes, (3) prawns, (4) mullets, (5) the live fishes, (6) the feather backs, and (7) the miscellaneous category which includes a number of minor carps, freshwater perches, eels and the small number of freshwater clupeoids. Both from the point of view of resources and potentials for increased production the carps are the most important and include the well-known forms Rohu [*Labeo rohita* (Ham.)], Calbasu [*Labeo calbasu* (Ham.)], Mrigal [*Cirrhina mrigala* (Ham.)] and Catla [*Catla catla* (Ham.)]. Less known but equally valuable in future expansion are *Labeo fimbriatus* (Bloch) and *Cirrhina cirrhosa.* The large-scaled barbels belonging to the genus *Barbus*, and under which comes the well-known Mahseer, form fisheries of considerable value in freshwaters and the large species are excellent game fish. The catfishes are a mostly carnivorous group and although some of them are excellent table fish, they are mostly active predators like the freshwater shark *Wallagonia attu*, and should not be allowed to grow along with carps.

Nevertheless at present a large yield, almost as big as that from the carps, comes from catfishes of the genera *Wallagonia*, *Bagarius*, *Pangasius*, *Silonia*, *Mystus*, *Eutropiichthys*, *Rita* and *Callichrous*. The category called 'live fishes' form a taxonomically divergent assembly having one common character, viz. their powers of aerial respiration and ability to be transported and kept alive outside water, which has been of much value in meeting the demands of fresh fish in various places. Species of *Clarius*, *Heteropnestes*, *Anabas* and *Ophicephalus* are included in this category; in many places in the Deccan special attention is paid to the culture of species of *Ophicephalus*. The 'feather backs' (*Notopterus chitala* and *N. notopterus*), the freshwater mullet *Mugil corsula*, eels and spiny eels of the genera *Anguilla*, *Amphipnous* and *Mastacembalus* and prawns of the genus *Palaemon*, principally *P. carcinus*, contribute to the remainder of the freshwater resources. Estuarine species which are taken in freshwater include *Hilsa*, *Setipinna* and *Etroplus* all of which are valuable and will be dealt with in the various sections below. The freshwater and estuarine fisheries are best exploited at present in the States of West Bengal and Orissa.

(ii) Estuarine Fisheries:

A second geographical peculiarity of the country which has influenced the pattern of Indian fisheries is the extensive development of estuarine and brackish-water tracts either as estuaries proper at the mouths of rivers as part of the river systems or as embanked brackish-water tracts near the coasts fed by rain and sea-water. The size and physiography of these coastal tracts vary a great deal, depending on whether they are in association with rivers, tidal creeks, backwaters or with large lakes, among which mention must be made of the Chilka and Pulicat Lakes on the east coast of India, both of which are typical brackish water lakes. They all have the common feature of extremely variable salinity conditions, but as the marine fauna of India has a large number of euryhaline species, the estuaries and brackish waters support a rich fauna including several commercially valuable fishes and crustacea. In fact as these estuarine and brackish water areas are zones of high biological productivity, they form excellent nursery grounds even for many coastal species of fish and prawns. Biologically, and from the fisheries point of view, the estuaries have close affinities with the sea as their fauna is predominantly marine and in almost all cases with the exception of *Hilsa*, the fisheries depend upon the colonization of these areas by young ones of marine species. A factor which has led to the extensive development of estuarine fisheries in the country is the fact that the areas covered are mostly shallow and exploitable without the employment of complex craft and gear.

Among the estuarine fishes, the most important is *Hilsa*. It is a migratory species of great value in the lower reaches of the rivers in Bengal and Orissa on the east coast, and of the Narbada and Tapti on the west. Mullets form another valuable group of estuarine species. The well-known Bekti, *Lates calcarifer*, the threadfins, which include species of *Polynemus* and *Eleutheronema* and many other euryhaline fishes, prawns and crabs contribute to highly productive fisheries in most coastal parts of the country.

(iii) Marine Fisheries:[1]

As regards the marine fisheries of India the striking feature is the differences between the western and eastern coasts of the Peninsula. As judged by the present day landings which are predominantly based on the fishing carried out within the narrow coastal range of 5-7 miles from the shore, about two-thirds of the total landings of marine fish come from the west coast, where apparently the water masses adjoining the coast are of an oceanic character and enriched by the nutrient-laden waters of the Bottom Antarctic Drift as well as by the Somali Current, which moves northwards from the coast of East Africa and sweeps round at the head of the Arabian Sea moving downwards along the west coast of India. The turbulance of the inshore waters, within the continental shelf which has an approximate width of about 50 miles, caused by the heavy Southwest Monsoon winds, the mud suspensions which probably act as reservoirs of nutrients, the presence of submarine ridges like the Carlsberg and Murray Ridges in the Arabian Sea are all factors which make the west coast having more productive fisheries than the east coast. The pattern of the east coast is largely influenced by the river systems opening into it, and the somewhat enclosed nature of the Bay of Bengal prevents active oceanic circulation. There is nothing at present to show that east coast marine fisheries are poor in off-shore waters; in fact rich marine fishing grounds have been located in waters off the mouths of the Ganga and Mahanadi at the head of the Bay in the exploratory activities of the cutters operating for the Bengal Government. The scientific evidence available at present points to the western coast being more productive.

Notwithstanding the broad demarcation indicated above, the fisheries of either coast are not uniform in character throughout the length of each coast. This may be seen from the following enumeration of the chief biogeographical zones as understood from the fisheries point of view. Starting from the north western part of India, the coast of Kathiawar has, in common with the Pakistan coast, an extremely valuable fishery of Sciaenids (*Ghol* and *Dhoma*) which appear in large numbers during certain seasons of the year, considerable landings of Polynemids (*Rawas* and *Daras*), Clupeids, perches and sharks and rays. Ghol, Daras, Rawas and Pomfrets are first class table fish occurring in large concentrations off Kathiawar. The Gulf of Cambay and the strip of the coast north of Bombay share many features with the Kathiawar coast, but owing to the influence of the Narbada and Tapti there is a development of the estuarine fisheries as well and, further down, the fishery for Bombay Duck, *Harpodon nehereus*, and eels is well marked. Both the *Ghol* and Bombay Duck are not pelagic in the sense we understand the mackerel and sardine fisheries which are best developed to the south of Bombay. The Konkan coast is noted for the mackerel, *Rastrelliger kanagurta*, enormous shoals of which appear during the October-January period. Mackerel is a most important fishery throughout the west coast of India from the Konkan to the Travancore coast, but shoals are not encountered to the south of Quilon. On the Kanara and Malabar coasts, the mackerel, although important, is partly eclipsed by the Clupeoids—more particularly the oil-sardine of Malabar, *Sardinella longiceps*, and the related forms *Sardinella fimbriata*, *Kowala thoracata*, and by species of anchovies. Several Carangids, Cynoglossids (*Cynoglossus semifasciatus*), sharks and rays and catfishes also contribute to the high annual yield of the Malabar coast. Polynemids and pomfrets are found in considerable numbers throughout the west coast. The prawn fisheries, composed of Penaeids are also well developed in the coastal belts of Malabar, Bombay and Travancore-Cochin. The general features of the Malabar coast, with a rich productive season during the period September-February and a lean season during the following months ending in total inactivity during the monsoon months, June to August, are in evidence up to about fifty miles north of Cape Comorin the southernmost point of India.

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[1] This section is adapted from the author's article in the Handbook of Indian Fisheries, op. cit.

The pelagic fisheries composed of sardine and mackerel disappear in the Comorin area, but their place is taken by midpelagic or demersal species, mostly perches (species of *Serranus*, *Lethrinus*), pomfrets (*Stromateus* spp.), the butter fish (*Lactarius lactarius*), sharks, rays and species of *Cybium* in considerable numbers. Small tunnies (*Euthynnus*) appear in shoals at certain places. The Wadge Bank near the Cape is one of the richest fishing grounds for percoid fishes and may well prove to be a lucrative trawling ground like some of the waters off Ceylon.

The Cape area has much in common with the east coast between the Cape and Point Calimere, where the fisheries are composed of numerous species, each contributing to a small-scale fishery consisting of Silver Bellies (*Leiognathus* spp.), pomfrets (*Stromateus* spp.) and Carangids (*Caranx* spp.). The waters of Palk Bay and Gulf of Manaar have considerable yields of *Belone* and *Hemirhamphus*, and the smaller Clupeoids *Dorosoma*, *Stolephorus*, *Dussumieria* and *Sardinella* and the large Clupeid *Chirocentrus dorab*. High yields are noticeable in this area of numerous perches of the genera *Lethrinus*, *Serranus* and Seer fish comprising species of *Cybium*. The waters between Tuticorin and Point Calimere are noteworthy in the possession of extensive chank beds, which yield a lucrative and unique fishery, as also of the pearl oyster in the Tuticorin area. The Palk Bay is a valuable fishing ground with considerable resources in leiognathids, elasmobranchs, cybiids, clupeids, and carangids, but the fisheries do not appear at present to be exploited adequately. From Point Calimere to Adirampatnam there are good grounds for sharks and rays and, during June to August, shoals of flying fishes (*Cypsilurus* spp.) appear off the coast of Nagapattinam and Cuddalore. In the same area there are also unexploited fishing grounds for perches and the lobster *Thenus*. From Madras to Vishakapatnam, the biggest shoaling fishery is that of the hair-tail or species of *Trichiurus*. This important area on the east coast is also noted for *Cybium*, *Leiognathus* and *Lactarius*. The Andhra coast appears to have numerous valuable grounds for shark fishing, especially to the south of Kakinada with considerable yields also in *Engraulis*, *Pellona* and *Stromateus*. Between Godavari and Ganga there are numerous small-scale fisheries, the predominant forms being species of *Pellona*, *Sardinella*, *Engraulis* and *Stolephorus* with subsidiary fisheries of species of *Arius* and *Cybium*. On West Bengal and Orissa coasts, *Hilsa* also appear in large numbers.

The most noteworthy feature of the east coast marine fisheries seems to be the absence of large shoals of mackerel and oil sardine, although small numbers of them are noticed; their place seems to be taken by the less valuable clupeoids, horse mackerels and leiognathids. It will be obvious from this survey that the fisheries of the east coast, which now yield only about a third of the total, are more diversified in character than those of the west. It is probable that the smaller output is correlated to socio-economic factors, not least of which is that the west coast fisherman is a better seaman and that conditions of transport and utilization here are not as well developed as in Malabar. While the west coast will be suitable for large-scale production followed by industrial exploitation of fewer fisheries like the clupeids, mackerel and prawns, the east coast would, if developed, substantially increase the supplies of sea fish for consumption in the fresh state in an area where the level of nutrition is already very low.

5. FISHERY BIOLOGY & FISHERY MANAGEMENT

General

It is futile to attempt fishery management without adequate knowledge of the biology of the fishes concerned, and in the present stage of our development it is natural that much attention should be paid to studying the biology of our commercially valuable species. This work is made somewhat difficult owing to certain natural factors over which we have no control. In countries with colder climates, speciation takes place less rapidly than in the tropics, and it is a common experience that in the place of single cold water species of importance we find in our waters a large number in the same family. In many instances instead of single species fisheries, there is in our waters groups of species comprising combined fisheries, most of them having such very similar features and apparently similar habits as to render their separation and study extremely difficult. Both in marine fisheries as well as in inland fisheries, sound taxonomic work is necessary for the correct recognition of species and subspecies. Much work on fish taxonomy has already been done in India, and excellent work continues to be done by the publication in parts of the series Fishes of the Indo-Australian Archipelago, started by Weber and De Beaufort, now being continued by the latter.

New Systematics

In former days most species have been described from single specimens and even when large series were available, the emphasis has been to find the extremes of characters rather than the range of common occurrence of particular characters. In recent times, thanks to the development of statistical concepts, increasing attention is being paid to the analysis of characters, based on frequency distributions and the correlation of characters with specific delimiting factors. Although we have a considerable number of workers on the taxonomy of fishes, their background is even now the museum concept rather than the genetical concept. This criticism can, in fact, be applied to many centres of taxonomic work all over the world. It is unfortunate that close study and analyses of characters based on large populations of species with a view to revising the taxonomy of groups of fishes of commercial value is not being taken up by any one. Investigations of this type are closely bound up with the problem of racial stocks of fishes which is so fundamental to understanding fisheries made up of species widely distributed as are most of the Indo-Pacific forms.

The 'New Systematics' which has emerged by the impact of genetical concepts on problems of taxonomy is equally dependent on physiological ideas on species and races. Physiological investigations have generally been lagging behind in India owing to the paucity of qualified workers, but the development of this discipline will be essential if we are to make sound progress in fish cultural practices relating to coastal, estuarine and marine fisheries.

Morphological Studies

Considerable progress has been achieved in morphological studies relating to fishes owing to the facilities for such investigations being available at most places. Many publications have appeared on various aspects of marine and inland fishes, their food, growth, occurrence, larvae, spawning seasons, life-history, parasites and a host of similar problems, but the large majority of these studies are random contributions and, even now, there are few species of fish of which it could be said that a reasonably allround picture is known. Examination of fish stocks, year classes, rate of recruitment, exploitable margin and such basic information relating to fisheries has not been obtained for any of our commercial species, although workers at the Central Fisheries Stations have begun to apply themselves to these aspects. Controlled growth studies, so essential for the development of fish culture on scientific lines, have hardly been attempted but here again recent efforts are being made both at Barrackpore and Mandapam. It could perhaps be said that on the whole the work at present does not match with the standards set by the more advanced centres of fisheries research, but the answer to this may be found in the introductory section. Apart from the late beginning, the preliminary stages required the development of almost a new discipline unfamiliar to the majority of Indian workers who also had to cope with inadequate facilities at various levels in their programme. What has been achieved during the past five years is encouraging, and one can say with confidence that considering the various difficulties which had to be surmounted in the initial stages, it is doubtful if more could possibly have been accomplished by any other band of investigators under similar circumstances. Objective fisheries research as has been developed in other countries has placed emphasis on varying aspects and in the integrated development of this science in our country, the orientation needed is for increased exploitation in marine fisheries, conservation of coastal fisheries and expansion of the culture fisheries.

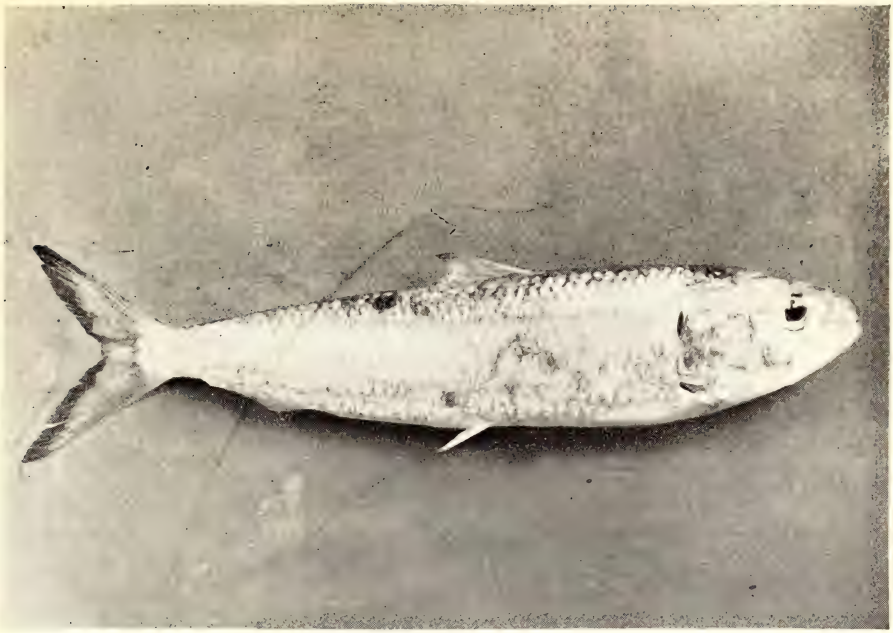
Applied *vs.* Pure Research

There is a small but influential school of thought in Indian scientific circles which considers that the fisheries institutions are devoting far too much time and energy to problems which are purely of an academic nature, unconnected with actual fisheries. This criticism is in a large measure unjustified, but it does not mean that there is no further room for improvement in the research programmes and their execution which, as workers become experienced, are bound to improve. On the other hand, inconsiderate criticism as has been voiced in certain quarters will react adversely on the overall necessity to obtain a larger measure of public support for scientific work on fisheries than is now available. It has already been indicated that there is much preliminary ground to be covered in the purely zoological and botanical aspects, which it would have been unnecessary for fishery workers to devote to, had knowledge of aquatic animals and plants in this country been sufficiently advanced. When any fishery problem is bound up with groups of organisms whose scientific study is inseparable from that problem, such studies have to be pursued by some members of the teams. Similarly it would be disastrous to the growth of scientific knowledge if workers begin completely ignoring any new fact or relationship which they may discover during the course of their work, although it may not be possible to give it the 'fishery' stamp. There cannot be any sharp distinction between pure and applied research. For the success of the latter, there will arise problems which have to be pursued with that amount of thoroughness necessary to establish facts with sufficient experimentation and control, which might give others the impression of an academic approach. Similarly, what some of these critics consider as academic are some of the very problems to which much attention is paid elsewhere. It would never be in the interests of fishery research and, in fact, of scientific advancement of the country to ignore the fundamental aspects of the various sections of a composite subject like the fisheries which is the meeting place of a number of disciplines of knowledge. Healthy development of new ideas and techniques can be expected only if the researchers are allowed a certain measure of freedom within the programmes without subjecting them to judgment based on short-term achievements of applied value. Nothing would please a fishery scientist more than the discovery of facts of practical value to the industry and to the country as a whole, but it is not his fault if short cuts to such findings do not exist.

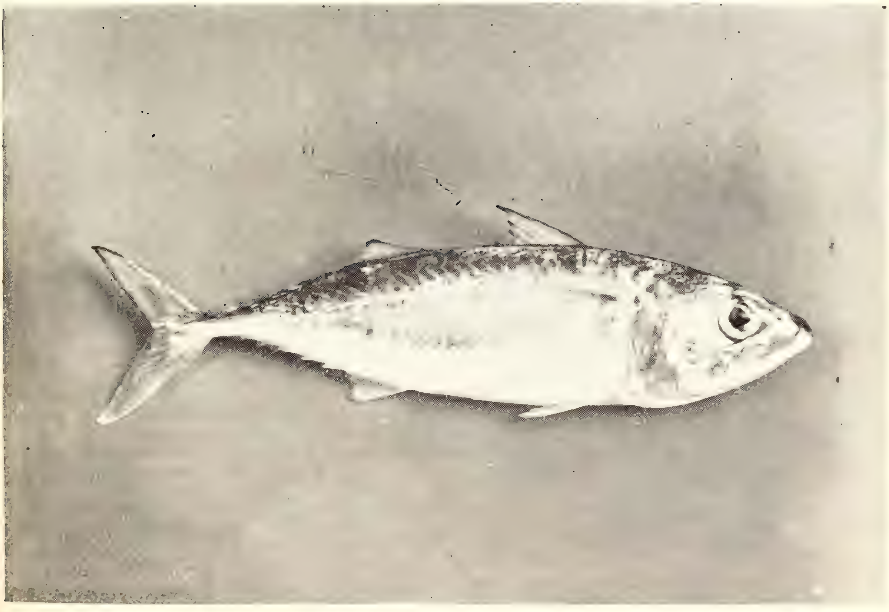
We may now examine the problems presented by some of the major fisheries both marine and freshwater. The oil sardine of Malabar and the Indian mackerel and the Hilsa will be discussed as they form outstanding fisheries in the country formed of single species. This will be followed by problems relating to group fisheries.

Sardines: The fishes belonging to the family Clupeidae rank first in world production; in India too they constitute about a third of the sea fish production represented by the oil sardine (*Sardinella longiceps*) and other related sardines (*S. fimbriata*, *S. gibbosa* and *S. sirm*), the anchovies (*Thrissocles* spp.), the white bait (*Anchoviella* spp.), the rainbow sardine (*Dussumieria acuta*), the white sardine (*Kowala coval*) and many other clupeoids yielding small-scale fisheries. There is large fluctuation in their annual yield, which is most pronounced in the oil sardine, the most valuable clupeoid of India. The species is widely distributed and is landed on the coasts of Arabia, Iran, Pakistan, Ceylon, Andamans and Indonesia, but large-scale shoals seem to be limited to certain areas only, for example the Malabar and Kanara coasts alone in India. The fishery starts after the commencement of the South-west Monsoon but the peak period is after September extending to January, a time when the entire coastal fishing population concentrate their efforts to catch sardines with large boat seines and gilling nets so efficiently operated in Malabar.

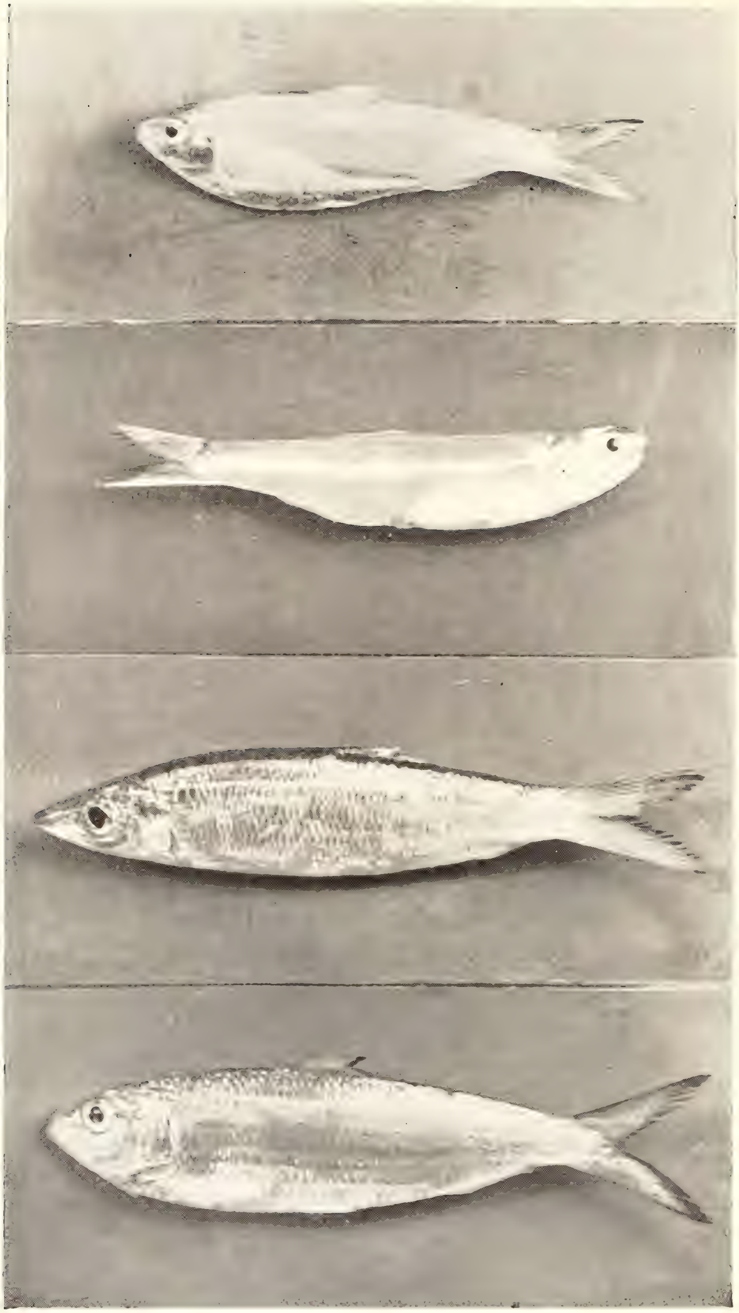
It will be easy to picture the calamity that would befall the industry if shoals which are accustomed to appear on the coast do not appear in certain years, or the shoals arrive at unforeseen times. But it is



Sardinella longiceps
The Oil Sardine of Malabar



Rastrelliger kanagurta
The Indian Mackerel



Other Common Sardines from the Malabar Coast

1. *Kowala coval*; 2. *Anchoviella commersonii*; 3. *Dussumieria hasseltii*; 4. *Sardinella fimbriata*

precisely the irregular and undependable nature of this fishery and the great decline of the shoals in recent years which have constituted a serious problem. Nair & Chidambaram (1951) have reviewed the subject. From their work the following table of landings for the oil sardine is reproduced below after adding the figures for 1950-52.

TABLE II

Statement of estimated landings of Oil Sardines from the fish-curing yard registers in the South Kanara and Malabar Districts

Seasons	Oil sardines landed in maunds		Total in maunds
	South Kanara	Malabar	
1925-26	6,50,707	5,41,742	11,92,449
1926-27	74,021	3,22,626	3,96,647
1927-28	63,673	1,29,339	1,93,012
1928-29	8,465	39,968	48,433
1929-30	42,122	31,656	73,778
1930-31	4,824	1,11,048	1,15,872
1931-32	17,175	41,378	58,553
1932-33	212	29,901	30,113
1933-34	7,96,805	11,26,788	19,23,593
1934-35	10,796	5,47,414	5,58,210
1935-36	961	39,188	40,149
1936-37	1,22,365	6,05,361	7,27,726
1937-38	76,445	3,79,592	4,56,037
1938-39	66,873	24,576	91,449
1939-40	78,240	1,11,724	1,89,964
1940-41	2,90,603	3,86,406	6,77,009
1941-42	13,442	1,05,789	1,19,231
1942-43	690	23,948	24,638
1943-44	5,867	5,991	11,858
1944-45	17,472	123	17,595
1945-46	195	281	476
1946-47	30	207	237
1947-48	25,494	6,419	31,913
1948-49	6,645	1,144	7,789
1949-50	16,083	74,744	90,827
1950-51	41,102	1,29,462	1,70,564
1951-52	19,500	2,71,694	2,91,194

TABLE III

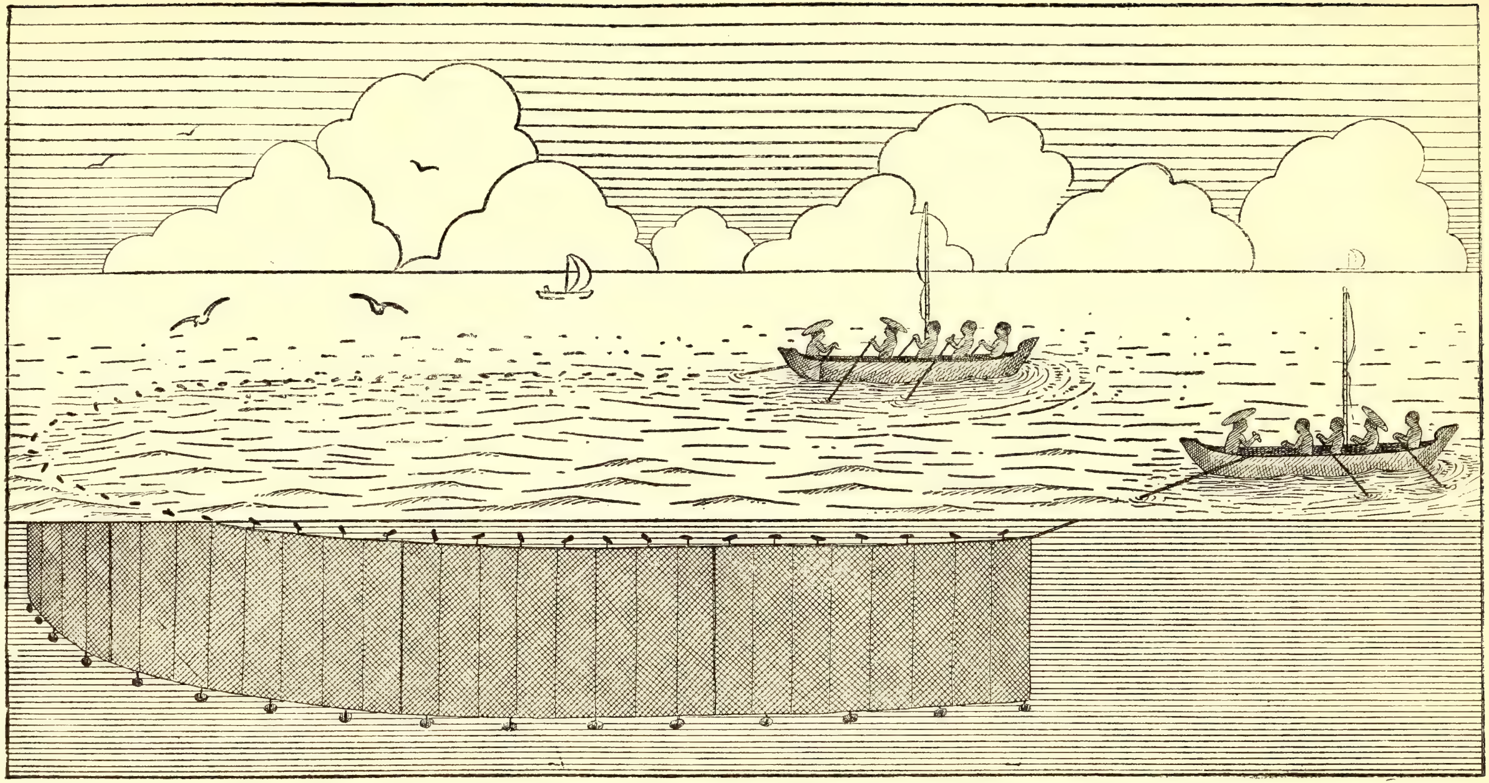
Table showing the approximate landings of Oil Sardines in South Kanara and Malabar for the years 1950–52

Month	S. Kanara	Malabar
	Mds.	Mds.
1950		
July	—	660
August	50	3,075
September	—	276
October	490	2,932
November	4,615	17,180
December	27,199	64,011
1951		
January	6,860	31,398
February	1,888	9,725
March	—	40
April	—	265
May	—	—
June	—	—
July	—	905
August	810	6,705
September*	11,595	71,590
October	6,475	1,58,444
November	—	1,010
December	520	5,070
1952		
January*	100	18,110
February*	—	5,110
March*	—	4,750

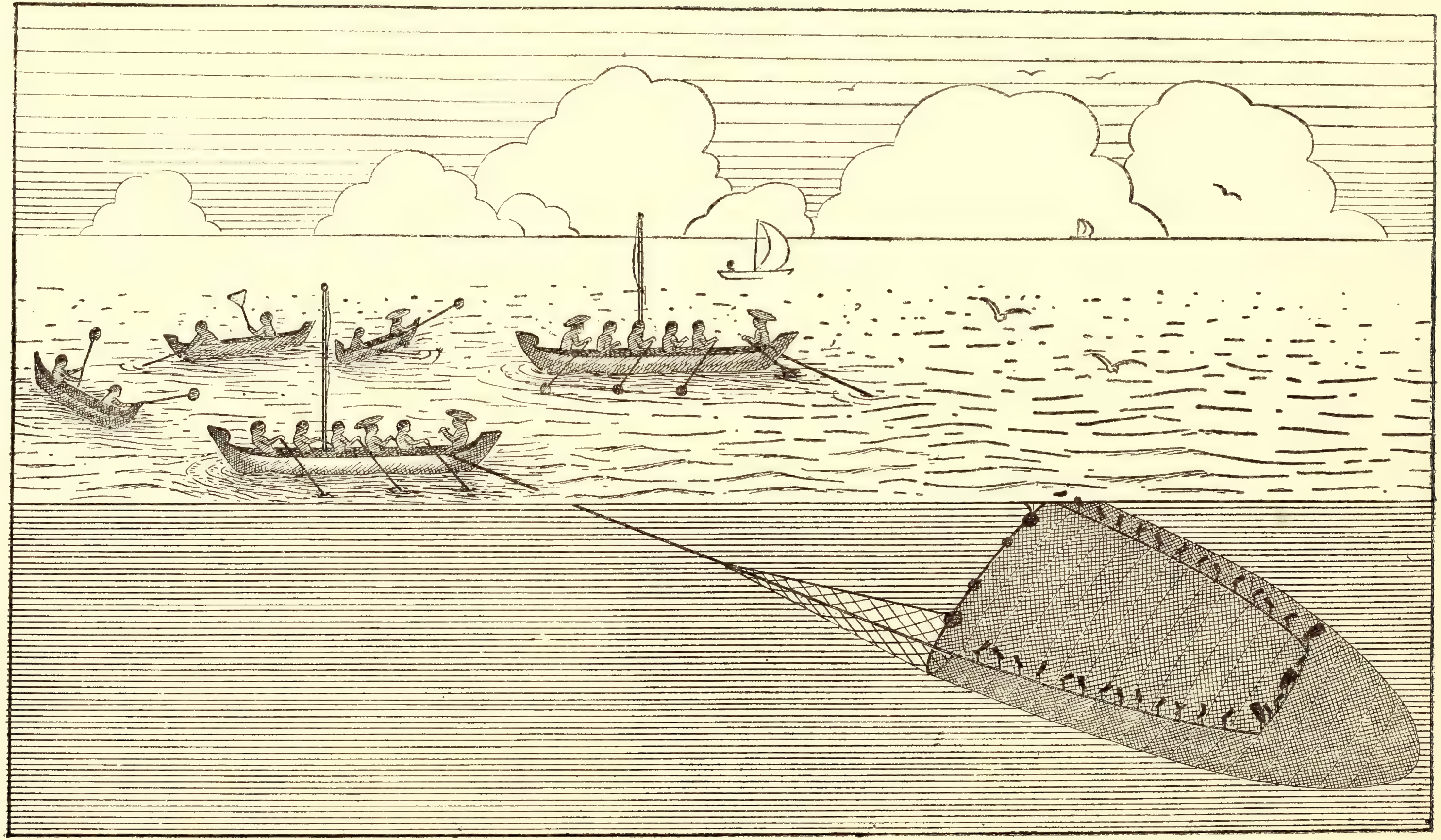
*Data incomplete.

The available statistics show that the fishery was extremely rich in the latter half of the last century which resulted in the oil extraction from sardines forming a lucrative industry with the increase in value of the oil. Large fluctuations were, however, evident in the landings even in those days, but from 1926 a new and unprecedented phase of decline set in. There was again a notable recovery in 1933-34 followed by further falls and slight recoveries, but the fishery dwindled to practically nothing in 1941-42. Improved landings were noticed again in 1949-50 and there has been an encouraging increase in sardines from that date; in fact the fishery as may be seen from the tables has been of some magnitude during the current year.

The oil sardine has been the subject of study by the scientists of the Madras State Government for a number of years; since 1947 the work has also been taken up by the Central Marine Fisheries Research Station of the Government of India. Various views on the length of life, spawning, rate of growth and other biological features have been put forward, but it is obvious that more reliable data are needed to establish many facts relating to its biology. The fish has a maximum size of 22-23 cms.; the commercial catches are predominantly the juveniles varying from 12–15 cms. All investigators are unanimous in ascribing



Sardine fishing in Malabar. Operation of the *Mathi-Chala Vala* (gill net) handled by two boats. The net is seen encircling a shoal of sardines. (Sketch by Shri R. V. Nair).



Sardine fishing by the *Mathi-Kolli Vala* which is a specialized seine net exclusively used for the oil sardines. (Sketch by Shri R. V. Nair).

the success of the fishery to the abundance of immature young sardines. The sardine is a plankton feeder and spawning is from August to November, probably commencing with the onset of the S. W. Monsoon. Sexual maturity is attained by 15 cm. sardines when they are certainly more than a year old, but the exact age of spawners is not established. According to Nair the life span is 3–4 years and sexual maturity is at the end of two years.

In the scientific study of this fishery one of the major problems to be solved is how far intensive fishing is inimical to the fishery. From the time of Day the possibility that the sardine fisheries were being over-worked was constantly in the minds of all investigators on the subject and it was believed by the fishermen that the introduction of the close-meshed 'Kolli vala' which was a much more efficient net for catching small-sized sardines than other nets, was one of the chief causes for the decline of the fishery. In olden days the sardines were caught only by the large Boat Seines or 'Paithu vala', but when the industrial demands for the fish grew regardless of size (which was immaterial in oil extraction) the more destructive nets were introduced.[1] In 1943 the Madras Government introduced legislation to protect the fishery in the Malabar and S. Kanara Districts. The legislation which was mainly intended to prevent the more efficient nets being used to capture the small-sized sardines throughout the year and to protect the spawners, lapsed in 1947. During the time the legislation was in force there have been many practical difficulties in its enforcement. It is fairly evident at present that enough is not known of the sardines to formulate legislative measures.

It would obviously be of the highest practical value to determine the causes responsible for the great fluctuation in the fishery, and thereby modify fishing operations so as to obtain a steady annual yield, at least avoiding total failures which would throw the entire shore establishment idle and, finally, to have a system of predicting the time and magnitude of the fisheries beforehand. If the fish cannot be had in their normal haunts, can they be fished elsewhere? If the recent decline has been due to overfishing, the establishment of close seasons to protect spawners and probably other measures will be necessary. The sardine fisheries is a world problem because their decline has been observed in various parts of the world. There is a considerable body of experts who attribute the wide fluctuations in these fisheries to cosmic factors beyond the control of man, and consider that under these circumstances protective legislation would serve no purpose. If the decline and fluctuations in any fisheries cannot be controlled, researches would all the same be extremely necessary to develop the prediction side of these fisheries by the correlation of oceanographical or other conditions with the abundance and availability of the fishes for fishing. The relationship of the oil sardine populations with other sardines, notably *S. fimbriata*, has also to be closely established to secure an overall picture of their relative abundance in successive years.

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[1] A seasoned fisherman of Mahê once told the author that the decline in the fishery was caused by the larger sardines forsaking the coasts in sheer disgust, on finding, from the refuse thrown back into the sea after oil extraction, what is happening to their young ones!

The Indian Mackerel *Rastrelliger kanagurta* Cuvier[1] is probably the most important marine fish of India. The fishery is composed of only a single species, it has a long season of occurrence, and the annual variations in the catches are not so high as in the sardine. It has been known for many years that lean sardine fisheries coincided with good mackerel fisheries and with the decline in sardines, it is only natural that mackerel is receiving much attention even in areas where they formerly had only the second place. The genus *Rastrelliger* is widely distributed, ranging from the Iranian Gulf to the South China Seas, and although three species have been described it is fairly certain that the Indian mackerel fishery is composed of a single species; further, it seems probable that the *Kembong* fisheries of the Malayan coast, and the *Pla-thu* of Indo-China and Thailand are all contributed by one and the same species. The districts of North Kanara in Bombay State, South Kanara and Malabar in the Madras State and the northern part of Travancore-Cochin State provide the chief areas of mackerel fishery, the actual range of the fishery on the west coast being from Ratnagiri south of Bombay to Quilon in Travancore. The season commences in September and continues till February. On the east coast of India, the fish appear rather erratically contributing to local fisheries near Mandapam, Madras, and occasionally as far up as Kakinada and Orissa. On the eastern coast of Ceylon there is a fishery from November to December. In essentials, its appearance throughout India corresponds to the colder part of the year although small landings of the species are by no means uncommon in many parts of the west coast during what is usually spoken of as the off-season. The fish is a plankton feeder and its shoaling on the west coast corresponds to a period of rich plankton production.

The mackerel of the commercial catches of the season are juvenile examples ranging from 18-21 cms. having very poor development of the gonads. In the monsoon months irregular catches of mackerel of all sizes varying from 7 to 24 cms. are not uncommon in Malabar (Chidambaram *et al.* 1951) and in the Kanara Districts. The juvenile examples of 18–19 cms. appear in shoals during October, and as may be expected the average size increases in the succeeding months registering the higher figures of 21–22 cms. by February and March. Although shoals disappear in the subsequent months, the mackerel obtained in small numbers are progressively larger, the maximum size being in the summer months, July and August (24–25 cms.) by which time the gonads are ripe, indicating a spawning period which corresponds with the Southwest Monsoon. This is supported also by the fact that very small mackerel from 9 to 11 cms. occur in the August/September period in Karwar, and small ones of varying sizes from 6 to 11 cms. in Calicut. It seems reasonable to consider that these small individuals do not form the fishery in the immediately succeeding months, the present indications being that it is the second year class that comprise the fishery. It is also a remarkable fact that mackerel collected in any one lot present an extraordinary similarity in the size of individuals comprising the catch, a uniformity that is most unusual in fish popula-

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[1] *Scomber microlepidotus* of Day's volumes. For recent account of taxonomy *vide* Beaufort in fishes of the Indo-Australian Archipelago. Vol. 9, 1951, Leiden.

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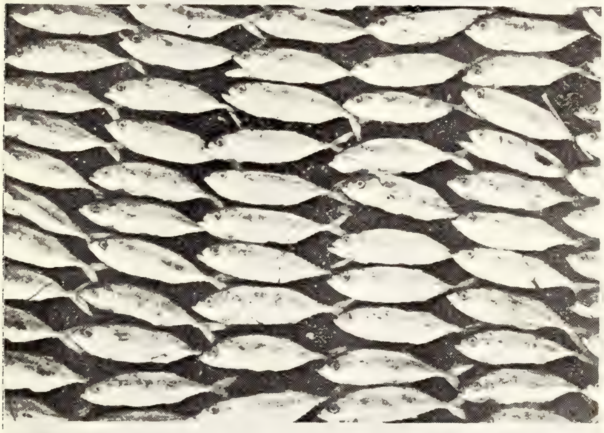
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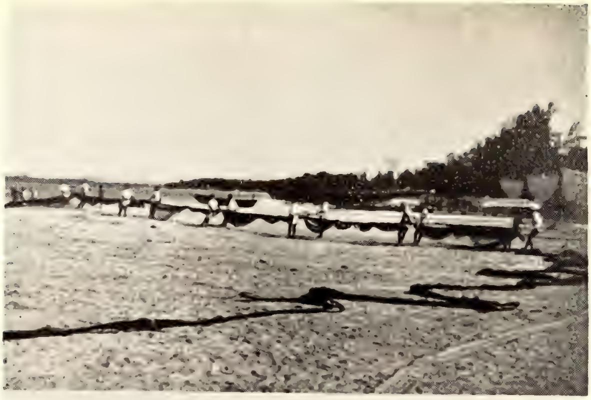
3

1. Outrigger canoes are extensively used in mackerel fishing. Photograph shows a canoe with mackerel in Karwar Bay.

2. Fresh mackerel gibbed, salted and kept for drying. Note the uniformity in size.

3. Mackerel fishing village on N. Kanara coast. Note the outrigger canoe, nets, fishermen, huts and curing yards.



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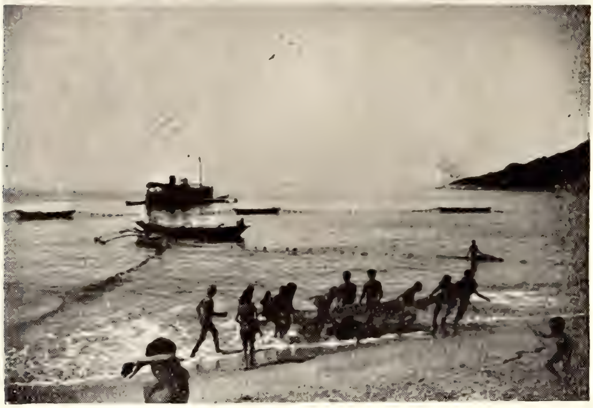

3

1. The Rampani nets, which are very large shore seines, are extensively employed in mackerel fishing in the Kanara coasts. The photograph shows one arm of the net being drawn ashore.

2. The mackerel encircled in the net are kept impounded near the shore until the arrival of launches from Bombay. Photograph shows the boats and impounding net with their floats.

3. Impounded mackerel are hauled ashore in batches as required. At the back may be seen a launch loading mackerel with ice for being transported to Bombay.

tions.[1] While such a uniformity may be expected of smaller examples not many months old, the very narrow range of size variation in a second year class is so pronounced as to throw suspicion on their age. It is needless to add that much remains to be known, but we shall have achieved much when a complete story of the Indian Mackerel is available to us: Where do the first year fish disappear to their feeding grounds? Which are the spawning grounds? Is spawning intermittent and extending for a long time as in the Atlantic Mackerel? What are the factors which control their movements and cause fluctuations in the fishery? We have no data to show whether the fishery is worked at its optimal level. The present operations are more or less coastal and it remains to be found out whether mackerel operations could be extended to the off-shore waters. Both sardines and mackerel appear earlier in the south and slowly extend northwards and their disappearance from north to the south also follows a similar pattern. These two fisheries require close study under an integrated programme because it is becoming increasingly clear that they form two major aspects of the *neritic pelagic complex* [2] of the west coast waters. Information is badly needed on the extent of off-shore stocks of both these fishes which are unexploited at the present time.

The introduction of carrier launches for the mackerel in 1936, and the steady increase in the fleet of launches operating between Bombay and the mackerel centres of Malwan and Karwar have had a healthy effect on the development of this fishery because it has become possible to land large quantities of mackerel for the people of Bombay at a reasonably low price. The operators have already shown a way of minimising the risk involved in the trade by the practice of impounding mackerel on the Karwar Coast, in the large Rampani nets in which they are caught, between the time of capture and the time they can be packed in ice in carrier launches arriving from Bombay. Researches on mackerel should further help in the prediction and assessment of the annual fishery, improvement in the efficiency of operations by closer knowledge of the habits of the mackerel and, above all, to assure that nothing is done to the stock of fish which might lead to decline in the yield as has occurred in the sardines.

(*To be continued*)

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[1] I am indebted to Prof. W. Rich who drew my specific attention to this point.

[2] The term was coined at the first meeting of the Indo-Pacific Fisheries Council at Singapore to denote the problems relating to the pelagic fisheries of the coastal areas as against true pelagic fisheries of off-shore waters.

THE HISTORY OF INDIAN MAMMALOGY AND ORNITHOLOGY

BY

SIR NORMAN KINNEAR, C.B.

PART I. MAMMALS

(*With three plates*)

The study of mammals in India in the first half of the last century owes more to Brian Hodgson and Edward Blyth than any other naturalist. Hodgson's work in Nepal and Sikkim laid the foundation of our knowledge of the mammalian fauna of the great Himalayan chain, while Blyth, owing to his facilities as curator of the museum of the Asiatic Society, had a wider influence since he had at his disposal specimens from the whole of India, Burma and Ceylon, as well as Afghanistan and the Malay Peninsula.

But before either of them had arrived in India Major-General Hardwick, head of the Bengal Artillery, had for many years collected specimens and employed native artists to make coloured drawings of them. He described a number of species, such as the Goral (*Naemorhedus goral*) and the Indian Gerbil (*Tatera indica*), but he was forestalled in his description of the Gaur and Four-horned Antelope. In 1815 Dr. Wallich, superintendent of the Calcutta Botanical Garden, went to Nepal to collect plants and seeds. He was a great friend of Hardwick and sent him a number of mammals, birds and many insects. Some of the mammals Hardwick described himself, while others he presented to the British Museum, the Zoological and the Linnean Societies. Hardwick seems to have been unfortunate in his dealings with the last named society, since according to the minute book for 1821 a description of the Panda (*Ailurus fulgens*) was communicated by General Hardwick and read in his absence, but never published. Again in 1823 his communication on the 'tail-less deer' *Cervus wallichii* and the sheep '*Ovis argali*' = (*Ovis hodgsoni*) met the same fate!

Hardwick returned to England in 1823 and some years later commenced publishing, in conjunction with Dr. J. E. Gray of the British Museum, the well-known 'Illustrations of Indian Zoology' (1830-1835).

In 1844 Dr. John McClelland in writing a review of Belanger's 'Voyage aux Indes Orientales' (1838) remarked 'We wish our own Government would take a lesson from the French, who seeing the interest of science neglected in the colonies of other rival nations, with an enlightened policy peculiar to the French, dispatched their own philosophers to supply desirata'. Before giving a brief account of the important work the French did in India, it is well to remember that one Governor-General—Lord Wellesley—did attempt to set up an institution for the study of natural history in the beginning of the nineteenth century. The scheme was to establish a college at Fort William and attached to it a natural history establishment at

Barrackpore where animals and birds were to be kept and studied. Orders were sent to officials in all parts of the Company's territories to send in live animals to Barrackpore. Dr. Francis Buchanan was appointed to take charge of the institution and undertake the official study of Natural History in India. Between 1800 and 1804 many animals reached Barrackpore, but Lord Wellesley's successor took little interest in the scheme; the institution degenerated into an indifferent zoological garden and gradually came to an end.

McClelland's remarks about the French were, however, quite true and one of their earliest travelling naturalists to visit India was Jean Baptiste Leschenault de la Tour, who arrived in Pondicherry in September 1816 to take charge of the Royal Botanical Gardens there. He travelled and collected widely in South India and visited Salem, the Nilgiri Hills, the French possessions on the west coast and then went south to Cape Comorin from where he crossed over to Ceylon. He returned to France in 1826. A year after Leschenault's arrival Pierre Medard Diard reached Chandernagore, where he was joined by Cuvier's step-son Alfred Duvaucel. These two naturalists accompanied Sir Stamford Raffles's expedition to Java in 1818-19. Diard went on to Sumatra and Indo-China and in 1825 joined the Dutch administration at Batavia. Between 1820 and 1825 he sent specimens to Paris but thereafter all his collections were sent to Leyden. He died at Batavia in 1863. Duvaucel parted from Diard in 1820 and went to Pedang and then returned to Chandernagore. From there he went to Sylhet and apparently visited the Khasia Hills, from where he returned to Calcutta in bad health and died in Madras in 1824. While at Chandernagore he visited General Hardwick at Dum Dum and made drawings of a four-horned antelope the general had alive. He also studied and made sketches of the animals at Barrackpore including the tail-less deer (*Cervus wallichii*), which had been sent from Nepal. Two of his native collectors he sent to Katmandu where they worked under Hodgson. About the same time a captain in the French mercantile marine, by name Dussumier, was very active in collecting specimens at many ports of call, which naturally were for the most part in the French possessions.

The specimens these naturalists collected were sent home to Paris where they were described by the Cuviers, Geoffroy, Blainville and others and included *Rousettus leschenaulti*, *Semnopithecus dussumieri*, *Cervus leschenaulti* (=*Cervus unicolor niger*) and *Cervus duvauceli*.

Four years after Duvaucel's death Victor Jacquemont arrived in Calcutta and remained in India some four years. He seems, however, to have been more of a traveller, and a very observant one, than a collector. In the course of his journeys he visited Delhi, the Himalayas, the Punjab and Kashmir from where he returned to Delhi and then went south to Bombay via Indore and Ajmere. He had intended continuing down the ghauts to Pondicherry and Ceylon, but he was taken ill and died in Bombay on 7th December, 1832. Jacquemont collected few mammals and though he described several the only name given by him which stands is that for the long tailed marmot *Marmota caudata*. More successful, however, was Charles Belanger, who reached Bombay in 1825 after a journey overland from

France. He travelled south to Malabar and then crossed the peninsula to Pondicherry from where he went to Calcutta. Thence he sailed to Pegu and after doing some collecting there he proceeded further south to Java and then returned to Pondicherry on his way home. He discovered several mammals such as the Rusty-spotted Cat (*Felis rubiginosa*) near Pondicherry and *Melogale personata* the Burmese Ferret-badger and the Tree-shrew *Tupaia belangeri*, both near Rangoon. The last French travelling naturalist is Adolphe Delessert, who came out to Pondicherry in 1834, but as he was more interested in birds than mammals details will be given under that section.

In October 1824 Captain W. H. Sykes of the Bombay Army was appointed statistical reporter to the Bombay Government and for the next seven years was engaged in this work. He wrote two large statistical reports on the Deccan and while gathering information on the subject also collected natural history specimens of all orders, which he gave to the Company's Museum in London in 1831. In the same year he published in the *Proceedings of the Zoological Society* a paper on the mammals in which he described the Indian Wolf *Canis pallipes*, the Wild Dog *Cuon dukhunensis*, the Indian Gazelle *Gazella g. bennetti*, and a number of others. In all he listed thirty-nine species with some information on their distribution and habits.

A deputation in 1839 was sent to study the tea plant in Assam. The party consisted of Dr. Wallich, Dr. William Griffith both botanists, and Dr. John McClelland, a geologist who was interested in natural history generally, especially fishes. They visited the Khasia Hills and McClelland made a collection of mammals and birds, which were despatched to the Company's Museum on the return of the deputation. With the assistance of Dr. Horsfield, the Keeper of the Museum, McClelland wrote a paper on his collections in the *Proceedings of the Zoological Society* for 1839. Of the nineteen different species collected the Macaque *Macaca assamensis* and the Giant Squirrel *Ratufa gigantea* were among his four new discoveries.

Sir Walter Elliot, better known as an archaeologist than a zoologist, served some seven or eight years in the Southern Mahratta country, now known as the Dharwar district. In 1839 he published in the *Madras Journal of Literature and Science* a 'Catalogue of the species of mammalia found in the Southern Mahratta country'. This paper was far in advance of any previously published on Indian mammals. Fifty-eight species are given with detailed descriptions and very good notes on habits and distribution. All this goes to show that Sir Walter was a very close observer and had he continued his studies no doubt he would have become one of the leading naturalists in India. In his introduction Elliot divides the various species into five categories, according to where they are found, as follows: (1) 'Common to all parts of the country where they are found', (2) 'Mountain forest', (3) 'Mulnad or rain country', (4) 'Black plain', (5) 'Sandstone and red soil'. Surely this paper must be one of the forerunners of the study of animal ecology! Many years later Elliot sent to the British Museum the skulls of several cetaceans obtained at Vizagapatam, together with notes of the colours of the fresh animals. These were described by Sir Richard Owen in a paper published in the *Transactions of the Zoological Society* for 1866.

Brian Hodgson went to Nepal as assistant to the Resident at Katmandu in 1820 and, with the exception of a break of eighteen months remained there till 1843. During the last ten years of his service he was Resident. Throughout his service he employed hunters to shoot and trap mammals and birds and every specimen which they brought to him was carefully measured, weighed and described. In addition he had one or two artists who made careful drawings of the feet, ears, etc., while fresh, and in some cases of the whole animal also. Skulls were always taken out and attached to the skins and sometimes entire skeletons were preserved, or at least parts of them. The weak point in Hodgson's collecting was his labelling of the specimens. Either no label was attached to the skin, or merely the name of the animal on native paper. In this Hodgson was not alone; few collectors in those early days realized the necessity for careful labelling. Nevertheless Hodgson brought together a remarkable collection and so far no important addition has been made to his Nepal list. One of the first animals he described was the serow which he named *Antilope thar* in 1831, and in the following year appeared his first catalogue in which twenty species are recorded by name but there are many others he was unable to identify[1]. His final catalogue published by the British Museum in 1846 records one hundred and fifteen species, including some ten or so from Tibet. It was owing to Hodgson's friendship with Bhim Sen, the Prime Minister of Nepal, that he was enabled to get specimens from Tibet and ultimately to send his own men there. It has often been said, and quite correctly too, that Hodgson described many of his species on unsatisfactory characters or too small material and also that he was always in a hurry to get priority. This last suggestion is not true since over and over again we read in his papers that he has known a certain animal for years but delayed describing it till he had further examples. In 1843 Hodgson left Nepal and came home to England but two years later he returned to India and lived at Darjeeling till he finally left India for good in 1858. The most remarkable animal which Hodgson named was the Takin. In 1846 a Major Jenkins, the Governor-General's Representative in Assam, sent him an imperfect specimen which was followed two years later by good examples of both male and female. It was while he was living at Darjeeling that Hodgson wrote his important paper on the 'Physical Geography of the Himalayas' in which he divided that mountain range into three altitudinal areas and described the animals inhabiting each.

When Dr. McClelland in 1840 started the *Calcutta Magazine of Natural History* among the contributors to the first number was a young officer of the 31st Bengal Native Infantry, in civil employ, stationed in the wild district on the south west border of Bengal.

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[1] In a footnote Hodgson writes: . . . 'My shooters were once alarmed in the Kachar by the apparition of a 'wild man,' possibly an ourang, but I doubt their accuracy. They mistook the creature for a cacodemon, or rakshas, and fled from it instead of shooting it. It moved, they said, erectly; was covered with long dark hair, and had no tail.'

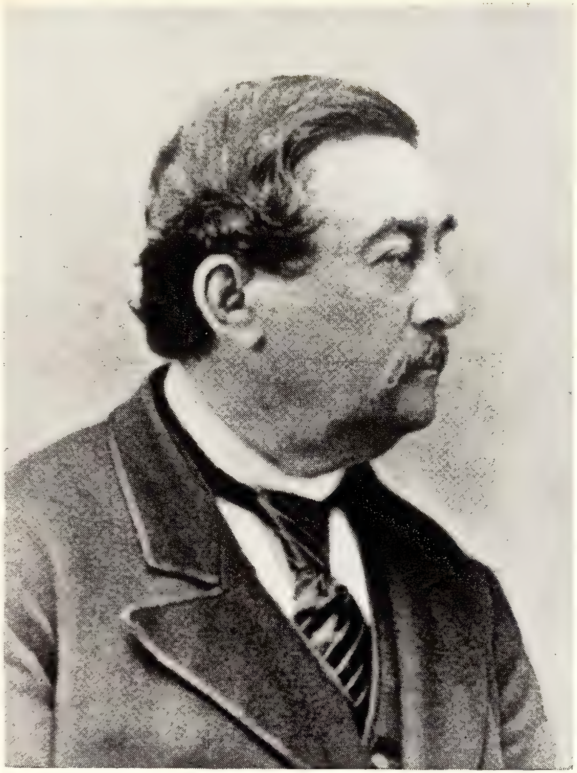
Here we have an early reference to the animal which has been exercising the minds of climbers in the Himalayas and zoologists who have never seen India!

This was Lt. R. S. Tickell, one of the best field naturalists India has known. His contributions included papers on the sloth bear, brown flying squirrel and anteater, and when he was stationed in Tenasserim he wrote a very good account of the habits of the gibbons. At one time Tickell intended to publish a book on Indian mammals and birds, but although his manuscript, and illustrations by himself, were all prepared, it was never published and is now carefully preserved in the library of the Zoological Society in London. When Blanford wrote the 'Mammals' he made frequent use of Tickell's MS.

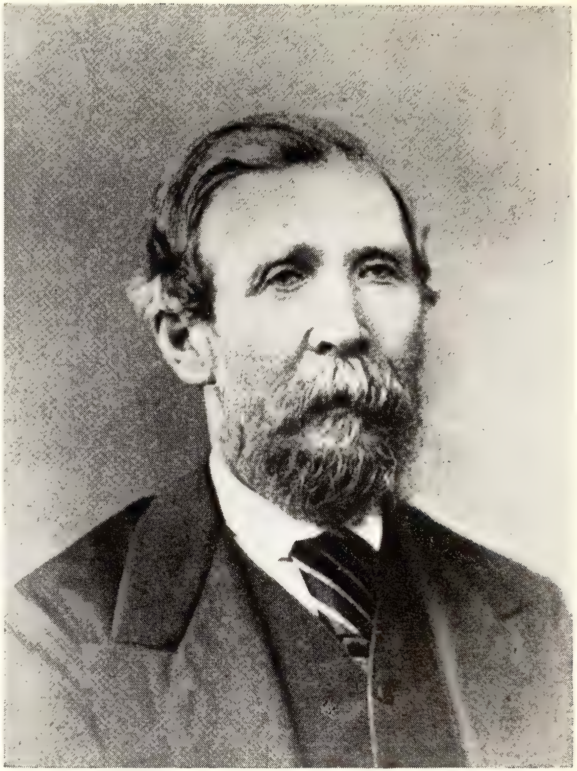
When the first Afghan war broke out in 1838 Lt. Thomas Hutton of the 37th Native Infantry joined the army of the Indus but was soon transferred to the 'Pay and Commissariat Department of Shah Soajah's forces' and bitterly complained that he had no time to get about. All the same he somehow or other did a good deal of collecting and wrote interesting notes on the Sind Ibex, Markhor and Urial; the last two he also named and described. In addition he sent some smaller mammals to Blyth for identification and, after the war, published a paper in the *Jour. Asiat. Soc. of Bengal* (1845) 'Rough notes on the Zoology of Afghanistan'. Hutton later was in charge of the 'Invalides' at Mussoorie where he continued his natural history studies and at one time was said to be writing a popular account of the Mammalia of the north western Himalayas, but it was never published.

In September 1841 Edward Blyth arrived in Calcutta to take charge of the Museum of the Asiatic Society. Before long he was in touch with many naturalists in India and the neighbouring countries and large numbers of specimens of many orders began to come to the Society. First and foremost of these correspondents was Dr. Jerdon, who became a great personal friend, then there was Col. Phayre, afterwards first Commissioner for Burma, and Major Birdmore, both stationed in Tenasserim where too was Ossian Limborg. The well-known Roman Catholic Missionary the Reverend J. Barbe sent specimens from the Tipperah Hills, Tenasserim and the Nicobars; Captain Hutton and Dr. Stewart from Mussoorie, Captain Tickell, Chaibassa, and Dr. Kelaart and E. L. Layard from Ceylon. R. W. Frith of Jessore made several trips for the Society to Cherrapunji and brought back many interesting specimens. Blyth was a man of great energy and in addition to carrying out his museum duties it was his custom to prepare reports for the monthly meetings of the Society of the accessions received since the last meeting. This was no mere list of specimens but a detailed account in which new specimens were described and attention drawn to others whether little known or new to the collection of the Society. Not infrequently he read a paper at these meetings and his choice of subjects was very wide, ranging from the 'Rats and Mice of India' to the 'Great Rorqual of the Indian Ocean'. Blyth had a remarkable memory, was very well read, and anything he wrote generally contained some out of the way information. On account of continued ill health he had to retire in 1862 and return to England, but not before he had finished the catalogue of the Mammals in the Society's collection, which his friend Jerdon saw through the press for him.

Dr. Kelaart, Blyth's correspondent in Ceylon, was in the Army Medical Service and when on leave in England had been persuaded

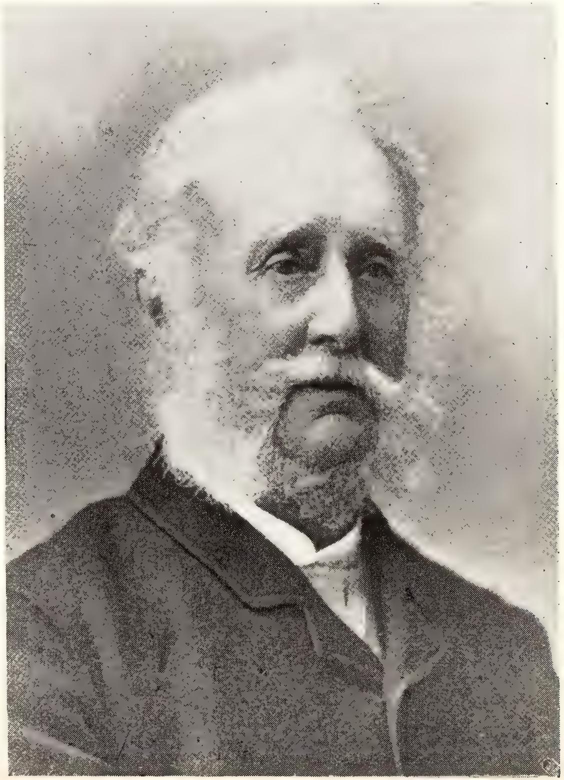


Samuel Richard Tickell
Died 1865



Thomas Caverhill Jerdon
1811–1875

(*Reproduced from "The Nests and Eggs of Indian Birds" by A. O. Hume, 2nd edn.*)



Brian Houghton Hodgson
1800–1894

Edward Blyth
1810–1873

by the head of the Medical Service Dr., afterwards Sir Andrew, Smith, to take up the study of natural history. In 1850 he published in the *Proceedings of the Zoological Society* 'A Catalogue of the Mammals of Ceylon' enumerating 58 species, and two years later his well-known 'Prodromus Faunae Zeylaniae' appeared. In the introduction to his work he remarks 'our own labours would, like those of many collectors, have been in a chaotic mess, but for the assistance of cabinet investigations of such eminent men as the Grays and Blyth'.

On 18th May, 1849 the 22 Foot—the Cheshire Regiment—landed in Bombay, crossed the harbour and marched over the ghauts to Poona. Their medical officer was A. L. Adams, who later became professor of zoology in Cork, a very keen and observant naturalist. Adams served with the regiment for seven years at Poona, Karachi and Rawalpindi and while at the last station made expeditions into the Himalayas and to Kashmir. In a paper in the *Proceedings of the Zoological Society*, 1858, he described the habits and distribution of the different mammals he had met with during his stay in India, and some nine years later published an interesting book entitled 'Wanderings of a Naturalist in India'.

In 1867 Jerdon's 'Mammals of India' appeared and for the next twenty-one years it was the standard book till replaced by Blanford's volume. Though confined to the animals found in Kashmir and the Indian peninsula, he frequently referred to species in Assam, Burma and Ceylon. In his introduction Jerdon admits that the portion of the work dealing with the small shrews, bats and rodents was very imperfect and this was not to be wondered at as the only collection he could refer to was the Asiatic Society's in Calcutta and many of the species described by Hodgson and Gray were not represented there. Then, too, he had to rely to a great extent on his own observations on the habits of animals, since little had been published except in the papers of Sykes, Elliot, Tickell and Hutton. Nevertheless the book filled a great want and Jerdon's own notes were excellent. In England Doctors Horsfield and Gray had been making known many new animals from India, principally collected by Hodgson, who continued to send consignments to both museums. The 'Catalogue of Mammals in the Museum of the East India Company' appeared in 1851 and two years later Hodgson sent his final donation to the Company's museum, which Horsfield described in the *Annals and Magazine of Natural History* (1855). This was an important paper and besides descriptions of new and little-known species there were notes on all the additions to Gray's 'Catalogue of the Mammals and Birds of Nepal' published ten years earlier. At the beginning of the paper Horsfield mentions that this consignment included a large supply of Indian ungulata, but except for the takin he makes no mention of them.

The year 1845 was an important one in the study of zoology in India since in that year W. T. Blanford arrived in India to join the Geological Survey. In addition to being an accomplished geologist, Blanford was a zoologist with wide interests and wrote many papers, not only on mammals but also on birds, reptiles and mollusca. He was concerned with the agitation which ultimately induced the Government of India to establish a museum in Calcutta, and there is little doubt but that he had much to do with the memorial which persuaded the Secretary of State for India to sanction the series of volumes known as the Fauna of British India, of which he was the first editor and author of four volumes. While engaged in geological field work Blanford had ample opportunities for collecting and seeing live animals, and when the staff of the Survey worked in Calcutta during the rains he devoted his spare time to studying the collections in the museum. He wrote many papers on mammals and one of his most important was the mammal portion of the 'Scientific Results of the Second Yarkand Mission' (1878). The specimens brought back by the expedition were collected by a young Austrian geologist on the staff of the Geological Survey named Ferdinand Stoliczka, who died on the way home when crossing a high pass[1].

Previous to this expedition little was known about the mammals of Kashmir, except the game animals and a short account in the fourth volume of Baron von Hugel's 'Kaschmir und Reich der Sick' (1840). Blanford's paper may therefore be said to be the basis of all future work on this region. During the next twenty years or so several officers stationed in Kashmir and adjacent agencies did good work in making known the local fauna, such as Biddulph and Scully in Gilgit, Macmahon—afterwards Sir Henry and founder of the Baluchistan Natural History Society—in Dir and Swat, Fulton in Chitral and at a much later date Colonel Stockley in various parts of Kashmir. During the first ten years of the present century Major Dunn, Colonel Magrath and Captain Whitehead collected in Hazara and the North West Frontier Province and helped to enrich the collections of both the Society and the British Museum. Between 1891 and 1894, Dr. W. L. Abbott, an American of independent means, who spent most of his life travelling and collecting for the Smithsonian Institution in the East Indies and East Africa, visited Kashmir on two occasions. On the second of these visits he travelled north as far as the Tian Shan following the same route as the Yarkand expedition. His collections were reported on in the *Proceedings of the U.S. National Museum*. It was not, however, till Colonel Ward of the Kashmir Game Department began to collect that the mammals of Kashmir became properly known. At first Ward collected himself, but latterly engaged C. A. Crump to come out from England and collect both mammals and birds. From time to time Ward sent short papers to the *Journal* giving the identifications of the specimens he had sent to the British Museum. In the first of these papers he quotes from a a letter he had received from Oldfield Thomas dated September 1904 as follows,—'I doubt if you realize that we have no specimens except yours of the commonest Kashmir species or indeed of India generally (except from Wroughton) and these we have moreover without the date, measurement etc. that nowadays make the chief value of specimens'. It is much to be regretted that no general account of the mammals collected by Col. Ward was ever published.

During the Afghan Delimitation Commission in 1896 Dr. Aitchison the official naturalist, and Colonel Yate, a member of the Commission, both made collections of mammals which were described in the *Transactions of the Linnean Society* and in the *Journal of the Asiatic Society*. When Colonel Younghusband's Mission went to Lhasa in 1904 Captain Walton, I.M.S., was attached as doctor and naturalist. He got together a small but interesting collection of mammals, some of which were collected in the same localities that Hodgson's men had procured the originals sixty-three years previously.

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[1] Stoliczka was buried in Leh. A photograph of his tomb is published at p. 656 of Vol. 32 (4) of the *Journal*.—EDS.

Not long after Blyth left India the Government decided to build a museum in Calcutta and in September 1866 Dr. John Anderson was brought out from home to be the curator. During his term of office he did much to increase the collections and in this he was helped by Dr. G. E. Dobson, an army doctor interested in bats, who besides writing many papers also wrote a monograph of the Asiatic Chiroptera (1876) which was based on the Museum's collections. Anderson did a considerable amount of collecting himself, accompanied the two Yunnan expeditions in 1868 and 1875, and at a later date went to the Mergui Archipelago. The collections made on the Yunnan expeditions were described in a special volume entitled 'Anatomical and Zoological Researches' (1878) and included an important memoir on a new river dolphin *Orcella fluminalis* captured in the Irrawaddy during the first expedition. Sir Arthur Phayre, the first Governor of Burma, a great friend of Blyth's and donor of many specimens to the Asiatic Society's Museum, had asked Blyth to write a general account of the mammals and birds of Burma. This Blyth was engaged in at the time of his death in 1873. The Asiatic Society later published the account in a special number of their journal along with a short life of Blyth. The mammal portion was revised by Anderson and Dobson, and the birds by Viscount Walden.

Between 1885 and 1887 Leonardo Fea of the Genoa Museum visited Burma and made extensive collections in all branches of natural history in the Bhamo district of upper Burma, and in Karennee and Tenasserim. The mammals were described by Oldfield Thomas in the *Ann. Mus. Genova* (1892).

In 1846 the missionary, the Rev. P. Barbie, S.J., wrote an account of the Nicobar Islands in the Asiatic Society's journal to which Blyth added a natural history appendix. Eleven years later the islands were visited by an Austrian scientific expedition in the frigate 'Novara' and considerable collections made. Towards the end of the mutiny Dr. Mouat was sent to the Andaman Islands on behalf of the government to report whether the islands would be suitable for a convict settlement and in 1863 he published an account of his visit in 'Adventures and Researches in the Andamans' with an appendix on the natural history by Blyth. It was not, however, till 1901 that the mammalian fauna of the two groups of islands was properly investigated. In that year Dr. Abbott accompanied by C. Boden Kloss, who afterwards was on the staff of the F.M.S. Museums, made a comprehensive tour of both the Andamans and Nicobars and collected a series of specimens which were described by Geritt Millar in the *Proceedings of the U.S. National Museum*.

The name of A. O. Hume is generally associated with the study of Indian birds, but he was also interested in big game and presented to the British Museum his collection of over a hundred heads and horns. In 1874 he described in the *Proceedings of the Asiatic Society of Bengal* the race of the Ibex from the Sind hills and of the Markhor inhabiting the Suleiman range. Two years later Major Sandeman, the famous frontier officer, sent him an Urial from Baluchistan which he named after Blanford. Hume also had a collection of mammal skins amounting to 400 specimens collected by his own men and some of his correspondents. This collection was presented to the British Museum in 1886.

Many different kinds of rats and mice had been described by Gray, Horsfield, Hodgson and others on various occasions, but it was exceedingly doubtful if they were all good species. This uncertainty was cleared up in 1881 by Oldfield Thomas who, in the *Proceedings of the Zoological Society,* published a paper on the 'Indian Species of the Genus *Mus*.' Besides examining all the old specimens in the British Museum, Thomas had at his disposal some material recently collected by Blanford in various parts of India, by Mandelli in Sikkim, Colonel St. John in Ajmere and the Rev. Fairbank at Ahmednagar. It is interesting to note that at that date the genus *Mus* included among other genera *Rattus, Bandicota* and *Nesokia*.

Two years before the Bombay Natural History Society was founded a memorial signed by Charles Darwin, Sir Joseph Hooker and other eminent men of science was presented to the Secretary of State for India recommending that a series of volumes dealing with the Fauna of British India should be published. This was eventually agreed to and Blanford was appointed editor and in addition undertook to write the volume on mammals which was published between 1888 and 1891. This work was a great advance on that of Jerdon, published some 20 years earlier, but the study of mammals had not advanced in the same way as that of birds had. Although many people in India were interested in the larger animals, few took any interest in squirrels, bats and the like. Furthermore, Blanford, who was working in London, had poor material at his disposal and many of the specimens had been exposed to light in the public galleries. In spite of some shortcomings in descriptions and distribution, for which Blanford was not to blame, this work was of great value to the student in India and was the first authoritative account of the mammals of the Indian Empire.

In 1884 Sterndale brought out his 'Natural History of the Mammalia of India and Ceylon', a popular work which was well received, and the same year saw J. A. Murray's 'Vertebrate Zoology of Sind', a compilation as regards the mammals and birds from Jerdon's works. The author of this last work was at one time in charge of the Frere Museum in Karachi and afterwards of the Victoria and Albert Museum, Bombay.

With the starting of the Society's *Journal* in 1886 a periodical became available where naturalists could record their observations. Among the early contributors there were two eminent Bombay lawyers, J. D. Inverarity a barrister, and Reginald Gilbert a solicitor, both of whom probably knew as much about the habits of big game as they did about the law! Interesting notes on bears and Himalayan game animals were contributed by Major G. S. Rodon, a retired officer of the Royal Scots, who had settled in India and every year spent some time in Chamba State. Then there was Colonel G. H. Evans of the Burma veterinary service, a popular figure in Rangoon, whose articles on the Thamin, Serow and Goral showed that he was a good observer. For long there had been a dispute as to whether the Gyal was a distinct species or a domesticated form of the Gaur and it was Stuart Baker who settled the question in the fifteenth volume of the *Journal*, but, alas, the four gaur heads which were depicted in the paper never came to the Society!

In 1871 R. C. Wroughton joined the Indian Forest Service and spent nearly the whole of his time in the Bombay Presidency. At first he was interested in Hymenoptera, especially ants, which he deserted for scorpions and through scorpions became acquainted with R. I. Pocock. At that time Pocock was in charge of the collection of Arachnida in the British Museum, but mammals were his real interest and in 1904 he left the Museum and became superintendent of the Zoological Society's gardens. But some time before that he had interested Wroughton in mammals and when the latter came home on leave in 1896 he brought with him a collection of bats which he worked out with Oldfield Thomas's help and wrote a paper 'Some Konkan Bats' in the 12th volume of the *Journal*. When Wroughton retired in 1904 he went to live in London and became a regular worker at the Museum. At first he had to work at African mammals because, as already mentioned, there was no recent Indian material available. He tried, however, to persuade friends in India to collect specimens but with little result, though the Society began to send a small but steady stream of rats, and Colonel Ward's consignments from Kashmir began to appear.

In 1904 Captain Glen Liston, I.M.S., read a paper before the Society on 'Plague, Rats and Fleas' in the course of which he said 'Hankin suggested that the accessibility of people to rats was more important than the filth, overcrowding etc.' He went on to say 'It is absolutely certain that rats are the most important factor in the spread of plague' and finally he added 'what do we know about rats, very little'. The last remark was only too true, and looking back it is extraordinary that nothing was done to properly identify the different species of rats or work out their distribution and biology. It must, however, be remembered that the importance of animals in spreading disease was not yet fully realized. A year after Liston's paper Dr. Hossack of the plague department, Calcutta Municipality, contributed to the *Journal of the Asiatic Society of Bengal* a 'Preliminary Note on the Rats of Calcutta' and this was followed two years later by 'An Account of the Rats of Calcutta with some remarks on the existing class function of the genus *Mus* and *Nesokia*', which was published in the first number of the *Records of the Indian Museum*. There was little new in either of these papers since the author was neither a naturalist nor trained systematist.

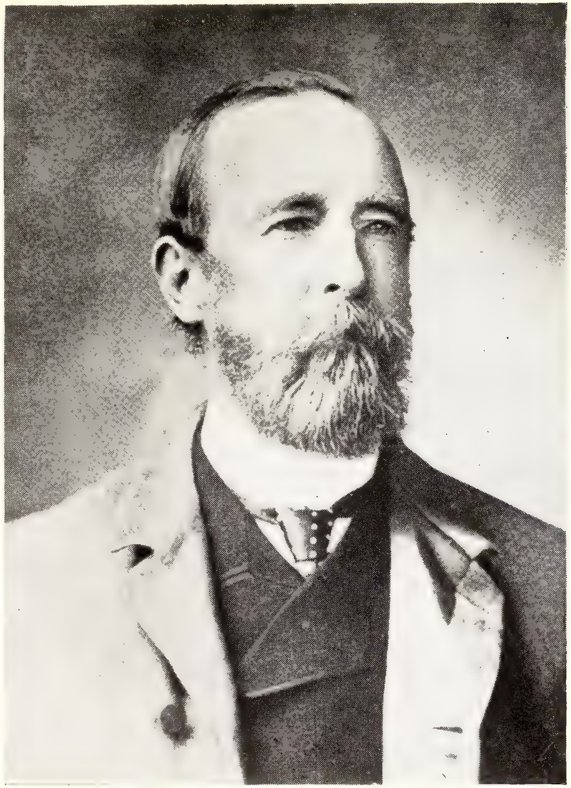
Liston's paper, however, encouraged members to send rats to the Society for identification and regular consignments used to arrive from Father Lord of the Cowley Fathers who worked at Pen in the Kolaba district across Bombay Harbour. Many of the specimens were forwarded to Wroughton who, when sending the identifications continually urged Millard that the Society should employ a paid collector, but the difficulty was the lack of funds.

At the end of 1911 or beginning of 1912 C. A. Crump suddenly arrived in Bombay and offered his services to the Society. Here was an opportunity not to be missed! Hurriedly calling a meeting of the Committee, Millard persuaded the members to allow him to engage Crump for some months and at the same time issue an appeal for funds. In April Crump started collecting in Khandesh and that was the beginning of the Mammal Survey. In the special Supplement commemorating the Golden Jubilee of the Society (1933) details are given of the money raised, the areas investigated and the forty-six reports issued.

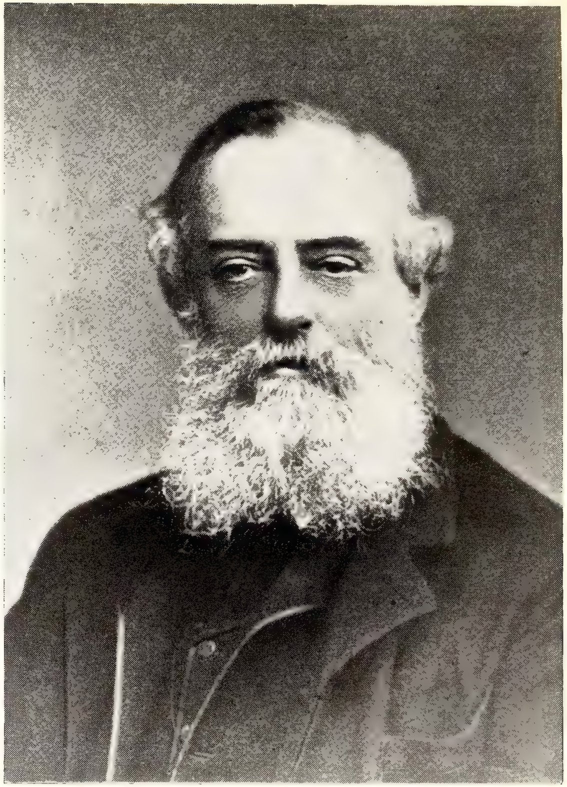
By the next year there were four collectors working, and then in 1914 the war came, the collectors gradually joined up and for a short time the work of the survey came to a standstill. But this was only temporary since, thanks to the assistance of members, the survey went on and one of the Society's assistants was sent to Darjeeling to carry on where Crump had ceased. In 1915 he was moved to Baluchistan to work under Sir Ernest Hotson who had joined the army, and with him also he went to East Persia. R. Shunkara Narayan Pillay, formerly in charge of the Trivandrum Museum, undertook to collect in Travancore, in various parts of Burma J. M. D. Mackenzie of the Forest Service collected in his spare time and Captain Philip Gosse, R.A.M.C., did good work in the Poona district and the Nilgiris. S. H. Prater, then assistant curator of the Society, was sent to work the Satara district and afterwards to North Sind. So it was that the work of the survey was continued all through the first war and soon after peace was declared Mr. Millard engaged another collector to come out from home. Other collectors were recruited in India and Charles McCann, who later succeeded Prater as assistant curator, also went into the field and did good work. In this way the survey carried on till the end of 1923.

During the time the survey was working some 25,000 specimens were collected including all the areas where the old collections of Sykes, Hodgson etc. had been made. The work of sorting and cataloguing this huge series of specimens was carried out in London by R. C. Wroughton assisted by his brother-in-law, T. B. Fry, who carried on the work after Wroughton died in 1921. In addition Wroughton prepared most of the 55 reports and made many contributions to the Scientific Results, besides being responsible for the 'Summary of the Results from the Indian Mammal Survey' the first number of which appeared in Volume 25 of the *Journal*. The Society owes a great deal to these two members for all the work they did, and it must be remembered that neither of them was young at the time.

At the Indian end there was the late Mr. Millard, a very busy man who nevertheless found time to keep the appeal for funds going, engage collectors, arrange where they were to go, supervise the despatch of specimens home etc., to say nothing of editing the *Journal* and looking after his own business. When Mr. Millard left India Sir Reginald Spence took his place and even in the difficult post-war years raised money to keep the survey going.



Allan Octavian Hume
1829–1912



William Thomas Blanford
1833–1905

(*Reproduced from "The **N**ests and Eggs of Indian Birds" by A. O. Hume, 2nd edn.*)

Briefly the results of the survey are that we now know what mammals are found in India, their characters, variation and distribution and it is unlikely that many remain undiscovered except a few shrews, bats and small rodents. It is interesting to compare the genera and species of one family—the rodents—as known to Blanford and the figures from the latest check-list.

Blanford, Fauna of British India, 1891: genera 22, species 93.

Checklist of Palaearctic and Indian Mammals, 1951: genera 44 species and subspecies 291.

The survey collections are a sound basis for future volumes in the new edition of the Fauna and were utilized to the full by Pocock in his two volumes. Without these collections Sir John Ellerman would have been unable to deal effectively with the Indian and Burmese species in his 'Families and genera of living Rodents' 1940 and certainly the very useful 'Checklist of Palaearctic and Indian Mammals' by Ellerman and Morrison Scott would likewise have been incomplete.

In addition to specimens the survey made available a very considerable amount of information on distribution, altitudinal range and the notes by the collectors supply particulars about habits and breeding. Both before and since the survey was started many valuable papers have appeared in the *Journal*, but the majority have been concerned with the large cats and big game on which there was already quite a library of books. A. A. Dunbar Brander's 'Wild Animals in Central India' is, however, of quite a different type and there is more in it about the behaviour of animals, not all of them game animals, than of how to shoot them. The author was fortunate to spend all his service in the forests of the Central Provinces, that classic ground of Forsyth's 'Highlands of Central India' and Sterndale's 'Seonee'. Lieutenant-Colonel R. W. Burton in Volume 41 has given an admirable summary of all that is known of the wild dog, while Sálim Ali's account of the wild ass in Kutch is a model of its kind. Useful observations on monkeys and different bats have been given by McCann, and in *Spolia Zeylanica* Dr. Osman Hill has described the breeding habits of certain monkeys in captivity as well as writing a 'Monograph of the genus *Loris*'. More is known of the habits of Ceylon mammals than of those of India thanks to Phillips's 'Manual of Ceylon Mammals' which contains much useful information. A similar work, but covering a much wider field is S. H. Prater's small volume 'The Book of Indian Animals' (1948) a veritable *multum in parvo*. The movements of bats are being studied by Humayun Abdulali, and two members Messrs. Powell and Frere have described in the *Journal* interesting particulars about two species of mongoose. Strangely enough there is little on record on the habits of the different kinds of rats though P. V. Wagle's 'Rice Rats of Lower Sind and their Control' in Volume 32 confirms some of Elliot's observations made many years earlier.

The members of the Society have always been interested in the conservation of the fauna and much has been done by members of the forest service. The great decrease in the numbers of rhinoceros, buffalo and certain deer led to a valuable series of papers on the 'Wild Animals of the Indian Empire' (1933-34) by S. H. Prater, with special articles by members in different provinces. From this it became evident that unless something was done certain species were in danger of disappearing. The establishment of game reserves at the foot of the Himalayas and in parts of Assam, it is hoped, may save the rhino and buffalo for the present. On the western side the lion still holds its own thanks to careful conservation; the wild ass, too, is strictly protected at least within Kutch State.

(To be continued)

THE HISTORY OF BIRD-PHOTOGRAPHY IN INDIA

BY

R. S. P. BATES & E. H. N. LOWTHER

(*With seven plates*)

It is indeed possible that photographs of Indian birds, or of their nests and eggs, appeared in other publications before ornamenting the pages of this journal, but we believe the contingency to be remote. In any case, even if such were the case, their numbers must have been very small. Consequently we have confined our researches into the history of bird-photography in India to the pages of our *Journal*, and since records indicate that the nest and eggs even of a British bird were photographed for the first time in April 1892, by Cherry Kearton, and of a bird at its nest not till the spring of 1895 (in this instance by that other great pioneer of bird photography, R. B. Lodge) we feel it is improbable that much, if indeed any, bird photography had been done in India earlier than 1900. We have therefore not looked through the *Journal* published prior to that year[1].

Neither of us being lucky enough to possess a complete set of the *Journal*, we repaired to the library of the South Kensington Natural History Museum where we spent two happy days browsing through their interesting pages, being afforded every assistance by Mr. Townsend, the Librarian, and by his staff. Often did we stray from our subject to read to each other scraps of absorbing interest, and as frequently did we have to pull ourselves up with a jerk to ensure completion of our task in the limited time at our disposal. As may be imagined nostalgic memories overcame us again and again, but we learnt much.

Some of what we learnt surprised us not a little, for it was not until we reached the fourth part of Volume 21 (November 1912) that we made our first discovery, a photograph by Magrath purporting to show the site of a bird's nest—that of the Orange Bullfinch. 'Purporting to show' is the right expression, for the photograph, or else its reproduction—a very possible contingency—is so poor that even a cross to show the nest's position entirely fails to give a clue to the composition of this strange smudge of printer's ink. This, being of a nest, cannot take pride of place as the first published Indian bird photograph. This honour apparently goes to C. Beadon who, to illustrate a Miscellaneous Note in Volume 24 (September 1915), in addition to pictures of a nest and eggs of the Common Sandgrouse, has one of the bird itself on the nest. Admittedly there are earlier photographs than those named, as for example that of a Ram Chukar taken in 1912, but these are of captive or wounded birds and as such should not, in our view, be included in this brief sketch, since bird photography, as understood by its devotees, means the portrayal of wild birds in their natural surroundings and under no form of human control.

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[1] Since this article went to press my attention has been drawn to a few photographs in the pages of the *Journal* which we appear to have missed out in our survey. One or two of these have perhaps been omitted in error, but others were undoubtedly rejected for technical or other reasons. The sudden death of my great friend and collaborator, Bob Lowther, renders it inadvisable, in my opinion, to make any alteration in this paper, but I find that the photograph of the female florican on nest in Vol. XXI (July 1912) is reproduced excellently at page 207 of Vol. II of Stuart Baker's Game Birds of India, Burma and Ceylon where it is credited to H. H. The Maharao of Cutch. The latter is also responsible for a picture taken on 8th November 1903 (Vol. XV of June 1904) of flamingos' nests and eggs in the Great Rann of Cutch. I would also like to mention F. M. Bailey's Bar-headed Geese photos (Vol. XIX of 1909) and his pictures of the nesting of the Ibisbill taken in May 1909 (Vol. XIX of February 1910).—R.S.P.B.

From 1915 onwards, until some time after the close of the Great War, nature photographs were used only sporadically, but in 1921 [Volume 27 (3)] there appeared an article which conveys the impression that the author's intent was to give to photography its due importance in supplementing the written word. This article, 'A List of the Birds of Dharmsala,' by Captain R. W. G. Hingston, was illustrated with 6 photographs, about quarter plate in size, of various nests and of a couple of birds—a Brownbacked Indian Robin and a young Himalayan Snowcock, the latter poorly reproduced. This article was the forerunner of those illustrated ornithological papers of both scientific and of a more popular nature which thereafter formed a steady if somewhat thin trickle up to the present day.

Up to this time the photographers' technique and the quality of reproduction left a great deal to be desired, but with the inception of E. H. N. Gill's 'A Description of the Nests and Eggs of the Common Birds occurring in the Plains of the United Provinces,' [Volume 28 (4) dated December 1922] a new era was ushered in. It is true that these photographs were still mainly of nests, but there is a crispness of definition and attention to composition about them, and those of the few bird photographs he included, which were previously altogether lacking. Unfortunately Gill's enthusiasm for ornithology appears to have waned with the conclusion of these articles, and by 1924 he had faded entirely from the Indian scene.

As Gill's articles were drawing to a close, one of the present authors, R. S. P. Bates, stepped into the breach, first with 'Notes on Hugh Whistler's "A Contribution to the Ornithology of Kashmir",' a short article with one plate depicting nearly life-size photographs of the nests and eggs of the Sooty and Whitebrowed Blue Flycatchers, and then, shortly afterwards [Volume 29 (4) May 1924] with the first of a series on 'Birds' Nesting with a Camera in India'. This series, in 6 parts, lasted until August 1926, and was written with the express purpose of popularizing the photographing of India's birds and to encourage the use of photographs in furthering bird study. We have repeatedly been told that, more than anything else published up to that time, it did focus attention on India's teeming and varied bird life and caused many to turn their attention to the birds around them, some for relaxation, some in a more serious manner, while the fillip it gave to those who were already bird enthusiasts was considerable. Perhaps few were induced to take up bird photography, but nevertheless from now on there was a small but noticeable

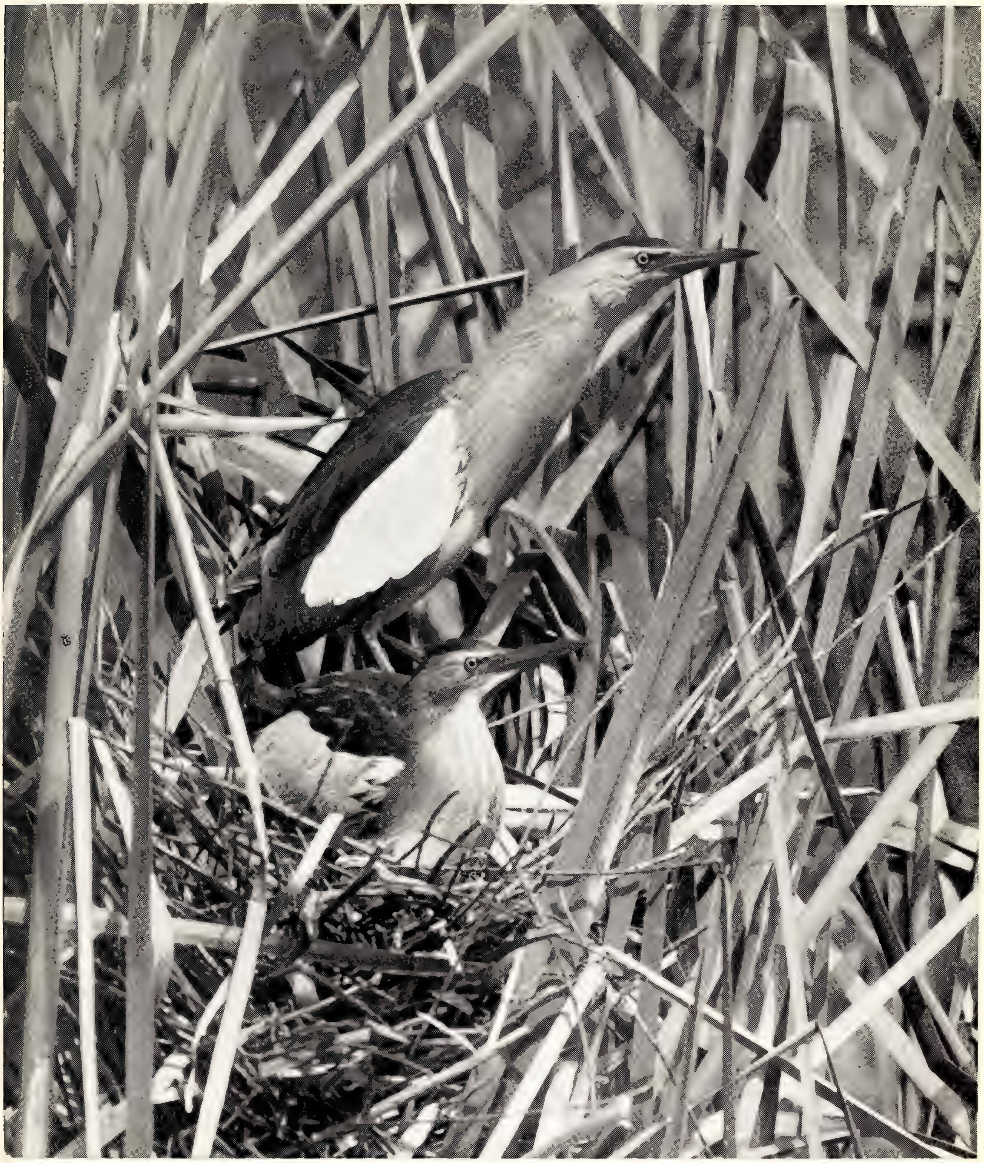

Photo *C. L. Boyle*

Little Bittern (*Ixorbrychus minuta*)

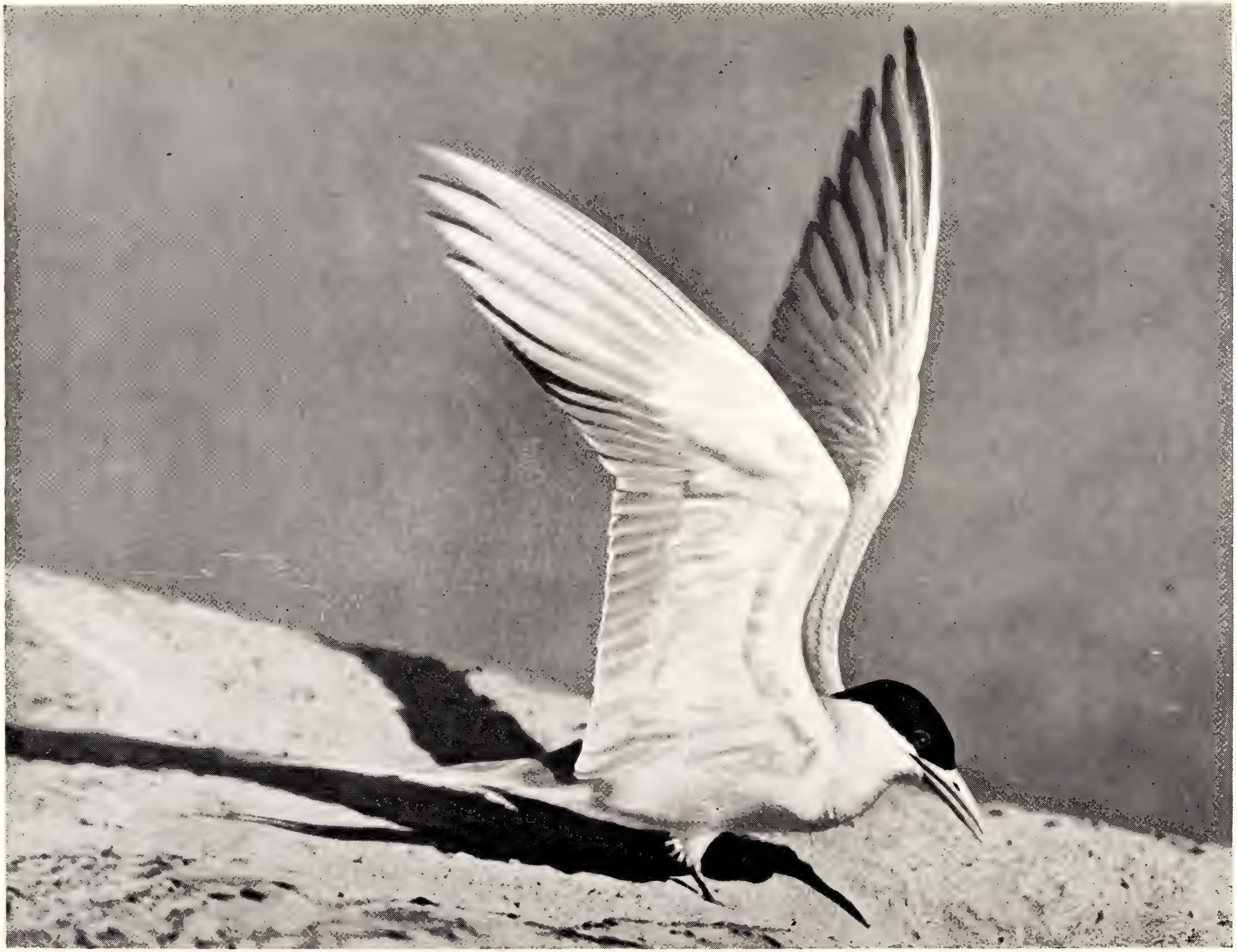

Photo R. S. P. Bates

The Indian River Tern (*Sterna aurantia*)

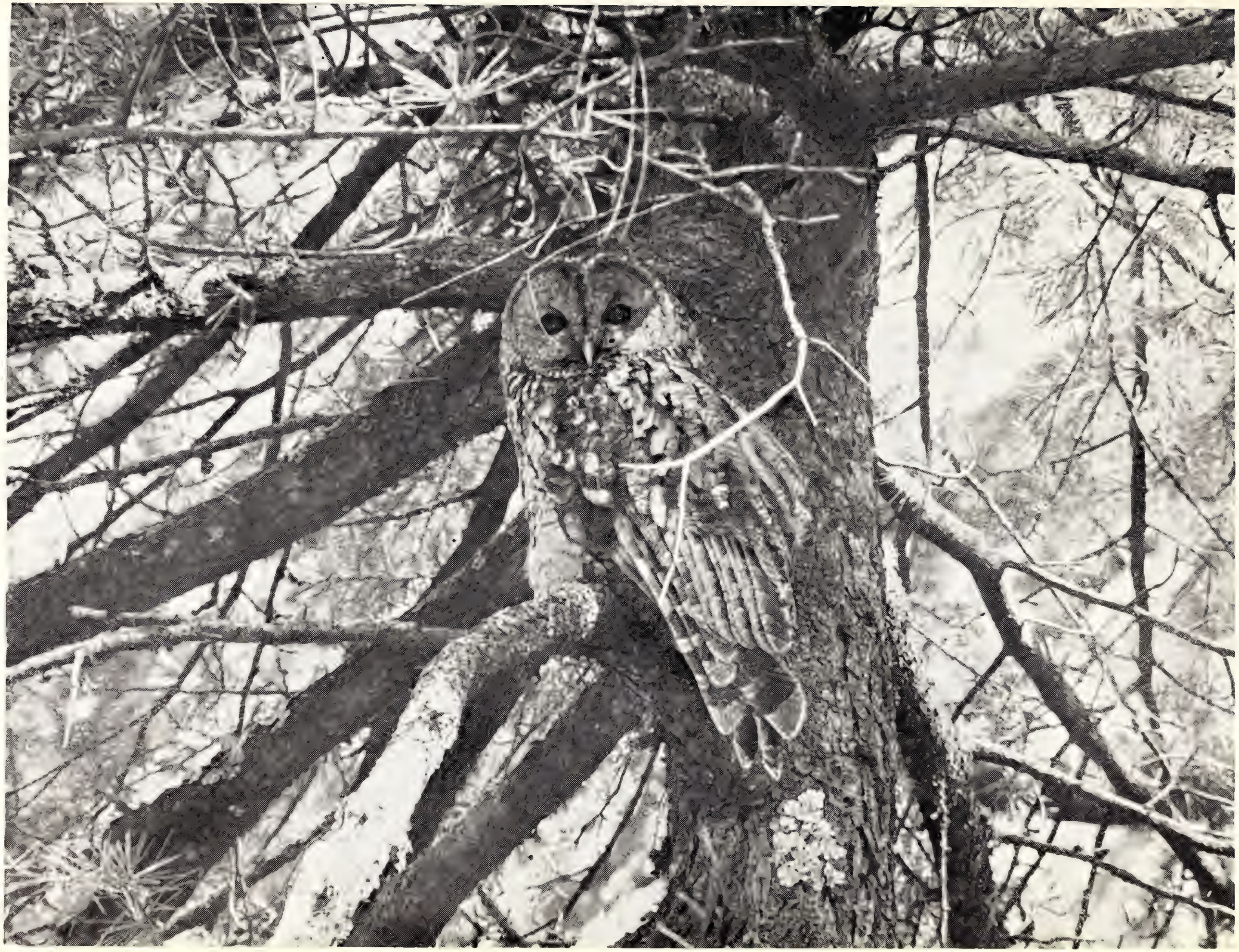

Photo R. S. P. Bates

Scully's Wood Owl (*Strix aluco biddulphi*)

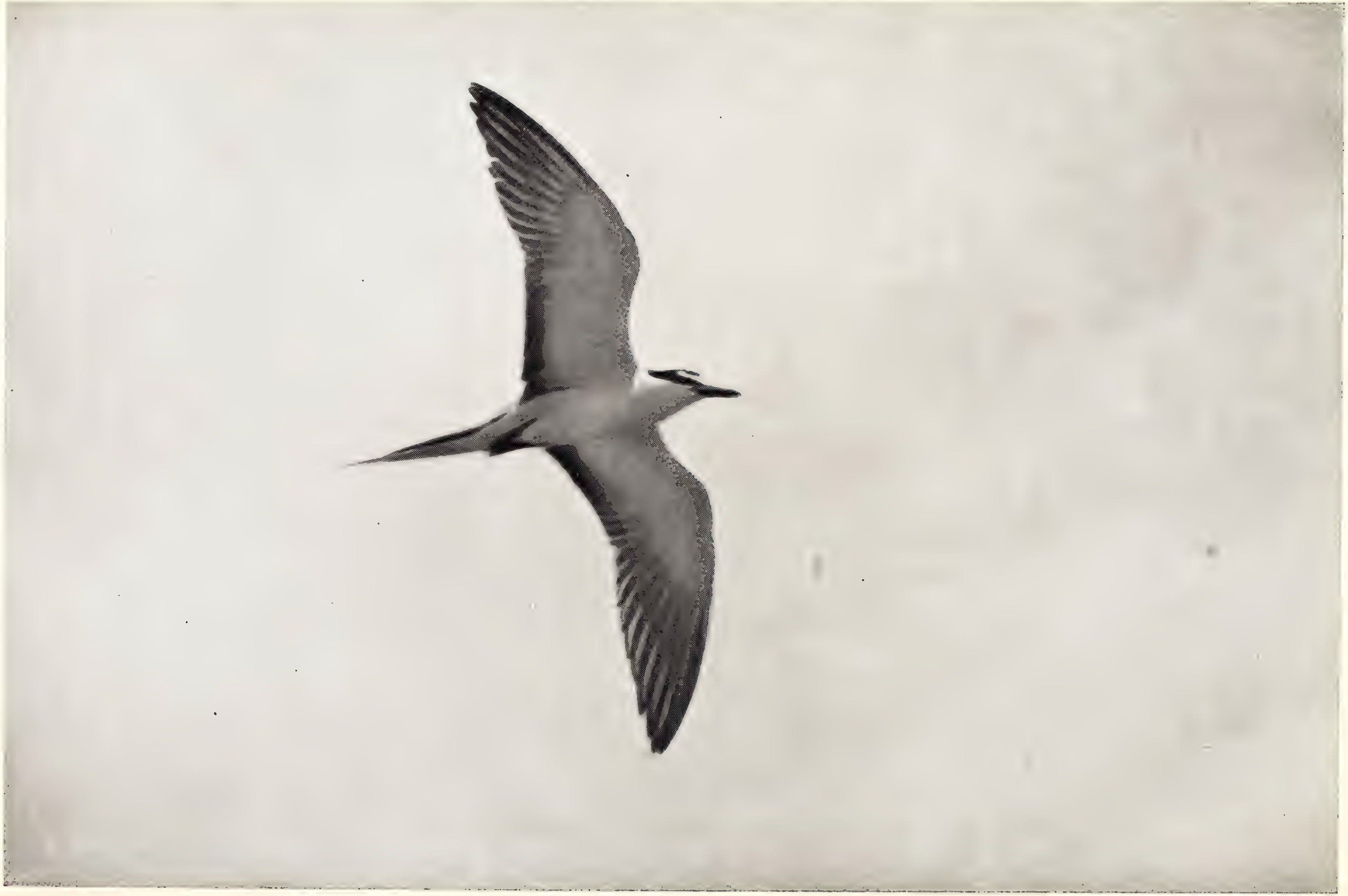

Photo C. A. Gibson-Hill

Brown-winged or Bridled Tern (*Sterna anaethetus*) in flight increase in the numbers using photographs to give point to their writings.

At the end of 1926 S. Basil-Edwardes put in a 'Contribution to the Ornithology of Delhi' with some habitat photographs, but alas this promising ornithologist died very soon afterwards.

The year 1927 saw illustrated works by three different authors. Bates's 'Impressions of Pachmarhi Birds'; C. B. Ticehurst's and Sir Percy Cox's 'Birds of the Persian Gulf Islands' with poor but interesting photographs of nest sites of Crab Plover, Cormorants nesting on sandbanks and gulls flying over their colony stealing the unguarded eggs; and Major R. W. G. Hingston's 'Bird Notes from the Mount Everest Expedition of 1924'. The four photographs illustrating the last, of Chough, Blue Rock Pigeon, Accentor, and Adam's Mountain Finch, though small, are very clear. From the end of 1928 until December 1932, except for Bates's 'A Reed-bed in the Dal Lake, Kashmir', illustrated chiefly with photographs depicting the life history of the Little Bittern [Volume 33 (3), May 1929], Sálim Ali holds forth with a series of articles dealing largely with the role of certain birds in the dissemination of plant-life, and in Volume 34 [(4), March 1931] with an outstanding contribution on the 'Nesting Habits of the Baya'. Although the photographs in this article can be said to be only fairly good, they are of exceptional interest. Unfortunately Sálim Ali is[1] a user of miniature cameras, instruments of great precision, it is true, but of limited use in straight bird photography. The miniaturist will no doubt take us to task for implying that first-class bird work cannot be turned out by the true miniature such as the Leica. We do not say that it cannot, since for certain work the Leica has given remarkable results. Some birds in flight and in the mass, such as the concourses at heronries, can be admirably depicted, but for bird portraits from the hide where a high degree of enlargement and the meticulous depiction of detail are required, it falls down except in the case of the largest birds.

With the introduction about this time of faster panchromatic emulsions, fine-grain developers, and photo-electric exposure meters, the task of the bird photographer tended to be simplified. For this reason one might reasonably have expected to find a noticeable increase in the numbers of nature photographers and an improvement in their work. There was in fact a slight increase in the output of bird portraits about 1935, but the Indian climate presents many adverse factors which more northerly temperate climes do not possess, so that only in the years following the last war is there an obvious improvement in achievement over previous work. The harsh lighting, the great heat of the spring, followed by the extreme humidity of the monsoon months, are not only factors which daunt the spirit and sap the energies of would-be photographers, and which have undoubtedly kept down their numbers, but have equally devastating effects upon the mechanical processes of development and printing and particularly bad effects upon exposed photographic emulsions if left unprocessed for any length of time. But thanks to the accumulated experience of the pioneers, and the steady improvement in materials and apparatus, those adverse factors are being overcome. In fact, we think it can be said quite fairly that a new era is opening in the art of bird photography in India. However, we must not anticipate.

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[1] But was not then.—EDS.

In Volume 37 (4) dated April 1935, in the same number in which Bates added his 'Notes on the Habits of some Indian Birds' with three plates, a new name appeared, that of F. N. Betts, with a short article on 'South Indian Woodpeckers'. Unfortunately the accompanying photographs are poor and much below Betts's present standard.

The year 1936 might, we think, be described as a good one. It started with Bates's article on the Kishenganga Valley and was followed by T. R. Livesey's 'Cuckoo Problems' and the first part of Sálim Ali's & Humayun Abdulali's 'Birds of Bombay and Salsette'—none of these illustrated with particularly good work. It ended in Volume 39 (1) of December, with the first part of the long and important series of E. H. N. Lowther's 'Notes on Some Indian Birds'. His opening gambit on the Crested Swift was not only a useful paper ornithologically but it introduced, with some unusual photographs of this bird of most remarkable habits, the work of a bird photographer who was actually in action even before Beadon published his portrait of the sandgrouse. In Part II, Lowther followed up his first published effort with a batch of noteworthy photographs of the different species of nightjars found in the plains. The series ran to 9 instalments which appeared intermittently throughout the greater part of the Second World War.

The fact that Lowther had been photographing India's birds since 1911 shows the danger of relying for this article only on the printed word, for no doubt there are many excellent bird-photographers who never blossom into print, a fact borne out by a perusal of the catalogue of the Wild Life Photographic Exhibition held in Bombay in April 1939 and the Nature Calendars issued by the Society annually since 1941. An outstanding example is Major C. L. Boyle who showed a fine series of 18 Kashmir bird photographs at this Bombay exhibition, including the best picture we have yet seen of both male and female Little Bittern at the nest. This photograph was also used in the Society's 1942 Calendar and is reproduced here. (Plate I.)

That good year of 1936 was the precursor of a ten-year period with a number of bird photographers in the field, by no means all of the Old Brigade. Apart from Lowther's series, more work came from Bates, his 'Rosefinches and other Birds of the Wardwan Valley' [Volume 40 (2), September 1938] being the first to be illustrated with photographs reproduced in the U.K. in a most pleasing manner in sepia by the Vandyke process. A number of the illustrations to papers by Lowther and Bates which followed were reproduced in this way, but in 1942 war conditions rendered it no longer possible to employ this process in the *Journal*. As permanent half-tone blocks are not prepared in this process, none of those photographs are available for reproduction here.

Amongst others at work during this period were Betts with two illustrated articles in December 1937 and April 1938, and C. McCann with some photographs of a deserted flamingo city in the Rann of Cutch,

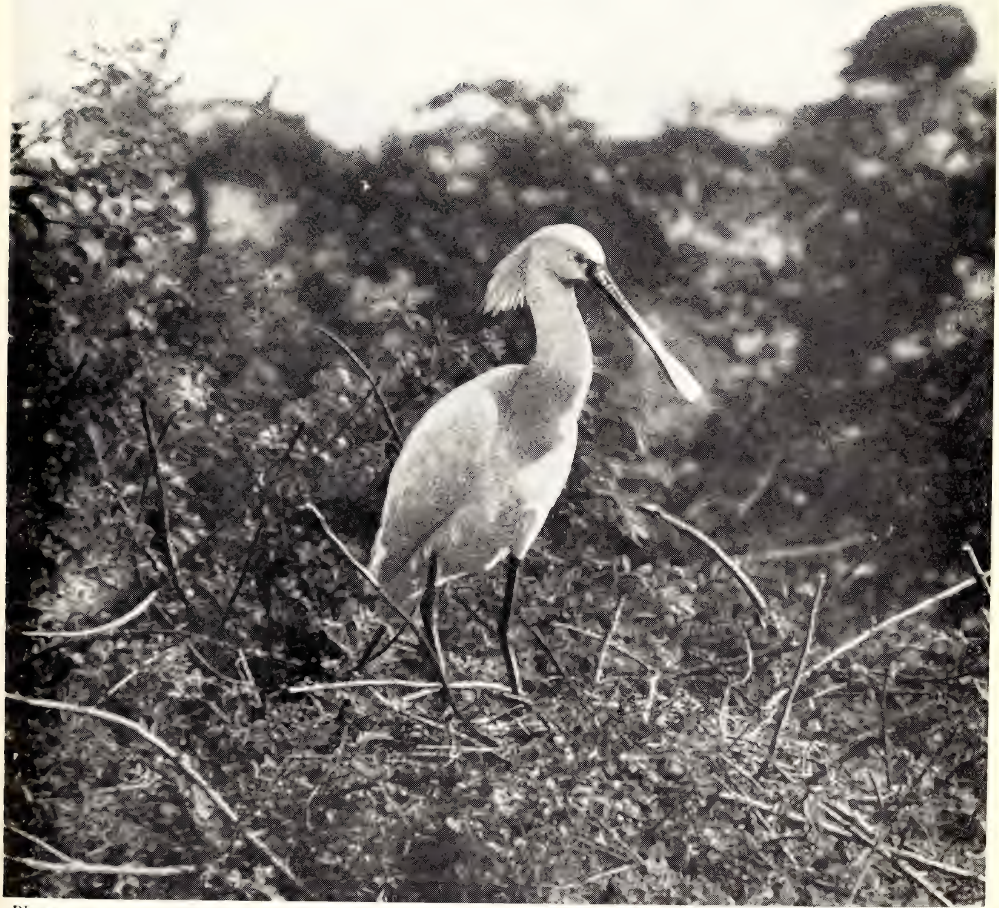
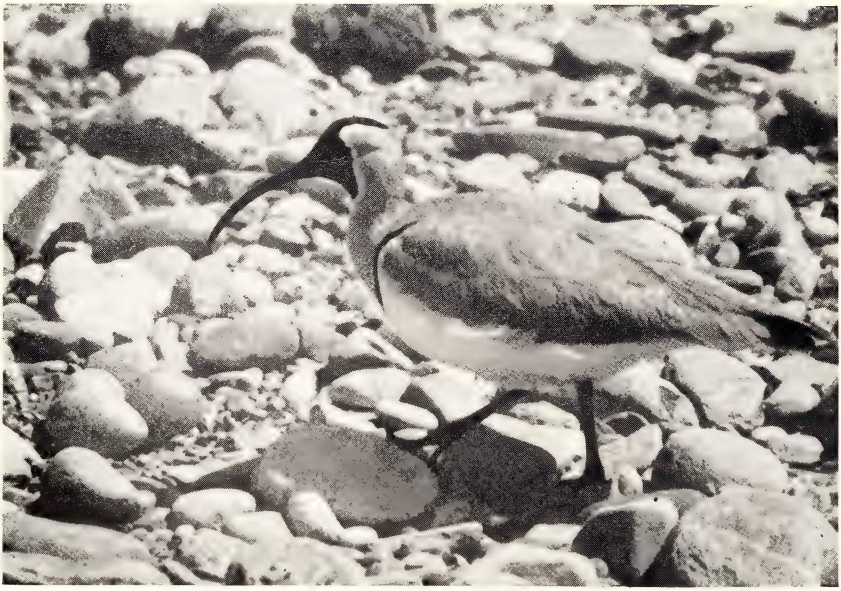
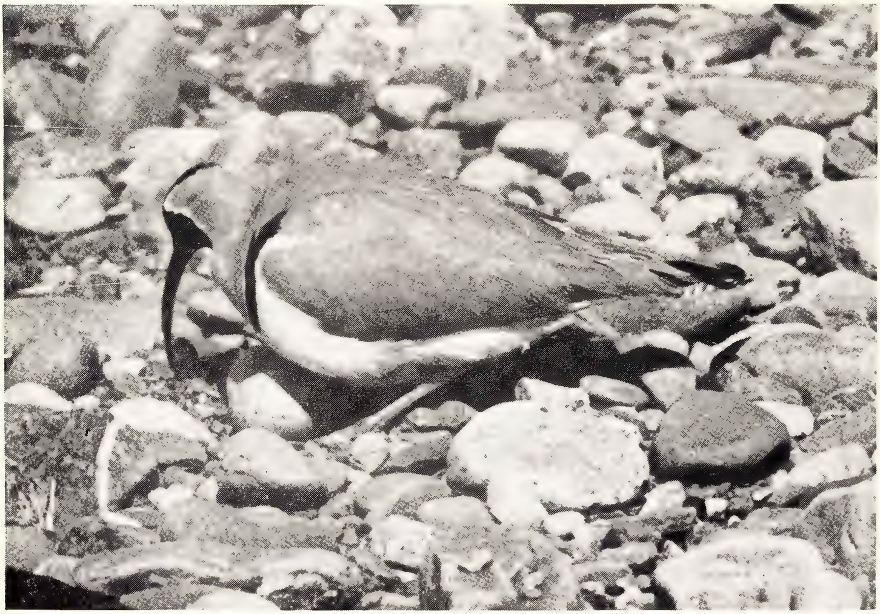


Photo *W. W. A. Phillips*

The Spoonbill (*Platalea leucorodia*)



Alert and with measured tread, the Ibisbill approaches the nest



Photos *B. T. Phillips*

Settling down to brood

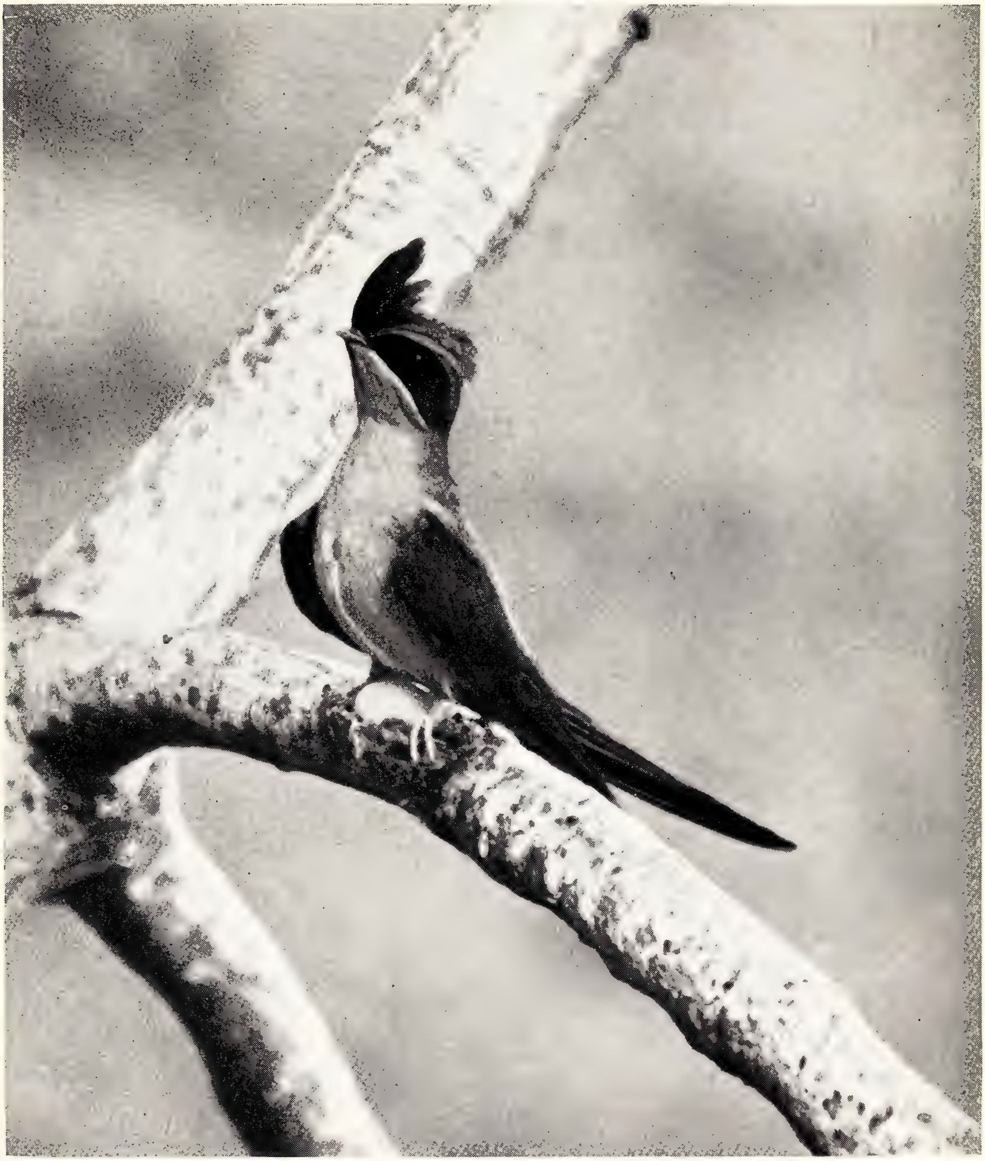


Photo *E. H. N. Lowther*

Crested Swift on nest with egg

and towards the end of the period W.W.A. Phillips has 'Some Observations on the Indian Courser'. Photographs by this author of a higher standard appeared in 1947 with an article entitled 'The Islet—A Bird Sanctuary in Ceylon'.

In September 1945 (Volume 45) the late Lt.-Col. B. T. Phillips was at last persuaded to venture into print. His first paper, 'Photographing the Ibisbill', was supported by some most illuminating photographs of this elusive and rarely-portrayed bird. Colonel Phillips concerned himself largely with colour work—his excellent transparencies cover nearly one hundred of Kashmir's birds and are a monument to his skill and experience in the use of the miniature camera in conjunction with the distant release. As his object was to produce colour transparencies for projection, his choice of apparatus was undoubtedly correct: the result of attempting to translate these same photographs into large-scale half-tone reproductions with which to illustrate his later series of articles, called 'A Bird Photographer's Musings from Kashmir', was not, however, altogether a happy one, for many of them show up his work to poor advantage.

In Volume 46 (2), August 1945, Sálim Ali illustrated 'An Ornithological Pilgrimage to Lake Manasarowar and Mount Kailas' with a mixed bag of small photographs some of which are really excellent, particularly of Horned Lark and Pamir Sand Plover, while, later in the same year W. T. Loke added 'A Bird Photographer in Kashmir'. On the photographs accompanying this article we have no remarks to make for the simple reason that they do not reflect the excellence of his later work and the fact that this summary is to be rounded off in the next article by his own explanation of the methods he now employs to obtain results which undoubtedly mark the opening of a new era in bird photography in India.

A perusal of articles from all sources appearing in these years shows a marked advance in technique and quality although Lowther's last paper on the Lämmergeier (Volume 46, December 1946) reveals a noticeable falling off. The rise and fall are easily explained. Before the war high-speed fine-grain panchromatic emulsions were already coming into their own and existing stocks lasted into 1943. Thereafter, to obtain a box of plates which was not so stale as to be almost useless—or which had not been salvaged in a partially wet state from a torpedoed vessel—became impossible. Lowther's long-awaited opportunity to photograph the most majestic bird of the Himalayas, the Lämmergeier, suffered for this latter reason.

Finally let us say that there are signs at last that bird photography in so far as India is concerned has emerged from its teething troubles, for in addition to the older names, the *Journal* and Calendars now contain work bearing such names as C. A. Gibson-Hill, whose studies of the tropical sea-birds are outstanding, K. S. Dharmakumarsinhji, the Maharao of Kotah and the Maharajah of Bikaner, O. C. Edwards and others. Bird photographers are undoubtedly on the increase in India but there are still far too few to cover but an infinitesimal part of the ground. When we look back and think of the photographic material at our disposal in the early days and compare it with the super-fast emulsions of great latitude, the fine-grain developers, and the aids to correct and silent exposure which now exist, whereby with comparative ease first-class photographs can be obtained by those with energy and determination, it seems to us scandalous that the ranks of the Society are not bursting to fill the *Journal's* pages with portraits of that multitude of India's birds whose secrets are crying out to be divulged.

In the British Isles the Zoological Photographic Club has been largely responsible for raising the standard of bird photography to near-perfection. Its membership being limited to forty on account of the circulation of work by means of portfolios, other clubs with a like object have sprung up, showing that in these islands bird photographers are to be numbered in hundreds rather than in tens. So buck up India, and if you have not yet started your Z.P.C., do so now to give a greater stimulus to the wonderful and useful hobby of bird photography. Personally we feel it deserves to be termed a science and an art, especially such work as that of W. T. Loke with the highspeed flash which heralds a new phase in the photography of India's teeming birdlife and a wonderful means of recording their every action.

* * * *

Note by the Editors

It is interesting to find that as early as the year 1900, in Some Hints on the Collection and Preservation of Natural History Specimens (Vol. 13; 279) E. Comber, under *Nests & Eggs* advises: 'Written descriptions of the materials, form and situation of nests can be enormously increased in value if supplemented by pictures of them taken while *in situ*; and now that the means for taking snap-shots is so simplified and brought to such perfection, every field naturalist should provide himself with one. Every one must naturally please himself of course as to the camera he selects, but, to those who have not already formed opinions, I can recommend the Eastman 'No. 4 Bullseye' which takes pictures 5 by 4 inches. Besides being cheap (cost between £2 and £3) it is a great advantage to be able to change the spool of films in broad daylight. Films of course *must* be fresh, and I myself find the best plan is to send a postal order for 25*s*. to Eastman's in London as fresh supplies are wanted; this covers the cost of postage of six spools of one dozen exposures each.'

PHOTOGRAPHING BIRDS WITH THE HIGHSPEED FLASH

BY

W. T. LOKE

(*With five plates*)

The use of the highspeed flashlamp (or electronic flash, as it is known in the U.S.A.) has undoubtedly caused what Eric Hoskings calls a revolution in bird photography.

The wonders of highspeed flash photography first became known to the world in the 1930's when a group of scientists at the Massachusetts Institute of Technology, headed by Dr. Harold E. Edgerton, perfected a system of taking photographs at very high speeds. Photographs taken at these great speeds showed bursting bulbs, bowls of milk at the instant they smashed on hitting the floor, the shape of footballs when kicked and other happenings hitherto unseen by the human eye.

During the last war this system, which consists of passing a very high voltage current through a tube filled with a rare gas or gases thus producing a bright light of very short duration, was found to be of great usefulness in night-time reconnaissance photography from the air. Since the war, the invention made available to the ordinary photographer has each year grown rapidly in popularity.

The main disadvantage of the high-speed flash is its great weight. The power pack for my own equipment weighed some 50 lb., and in addition there were the usual camera and tripod plus two lamps which needed a tripod each.

The 6-volt current from the batteries is stepped up to some 2,500 volts before it is discharged through the lamps. When working in the field, often under damp conditions, it is essential that the connections between power pack and lamps be completely safe from leakage, otherwise the photographer handling them might easily be killed.

During my recent expedition in Kashmir (1951), I used the speedflash for the first time for a period of continuous work in the field, and the lessons I learnt may be of some use to other bird photographers. I am not competent to deal with the technical aspects of speedflash photography, but from the practical point of view several qualities are desirable :—

(1) The light should be of high intensity to allow for exposures at small stops. When using a telephoto lens, it is clear that good depth of focus is of very great importance.

(2) The flash must be of short duration. My set gave me an exposure speed of about 1/3,000th of a second. This was not fast enough to 'freeze' the movement of the smaller birds such as the Bluechat. It could, however, deal quite adequately with a slow-flying bird like the Hoopoe. I am certain that for a bird like the Central Asian Kingfisher, an effective speed of at least 1/10,000th of a second is essential.

(3) Quick re-charging of the condenser is useful. As a light of high intensity is important, the transformer naturally has to be large, and weight in the equipment is unavoidable.

(4) The leakage of current from the condenser is usually designed, as a safety measure, to empty it in about 1 minute. It should be possible to lengthen this time to, say, 3-5 minutes. For ordinary use this would be dangerous, but birds quite often do not visit the nest for long stretches at a time and it would be a distinct advantage for the bird photographer to be able to make his battery last longer by having to charge his condenser less often. When on trek, one's constant worry is when the battery is going to run down. There is, of course, no hope of getting the battery recharged in Kashmir, for instance, except when one reaches a place like Pahalgam or Srinagar.

In the early examples of speedflash photography, it was not unusual for the pictures to have inky black backgrounds which made the bird look as if it was flying by night. This look of unreality may be avoided by either photographing the bird with a background close enough to be illuminated by the lamps, or choosing a point where the bird is in shadow but the distant background in full sunlight. The photograph of the Hoopoe (Plate II) was taken by this later method.

I found that in most cases two lamps were necessary. The use of a single lamp causes dense shadows in the photograph which are ugly and can only be avoided by using a supplementary light source to light up the shadows.

It is unwise to photograph when it is raining, even if the rain is only a slight drizzle. Apart from the damage likely to be caused to equipment and the danger involved, raindrops get 'frozen' and in the photograph appear as round blobs which (as this happened to me) made me think at first that my film had deteriorated.

A developer which will give good shadow detail is essential and I found 'Promicrol' from this point of view most satisfactory. My camera was a quarter-plate Speed Graphic and I used a 10-inch telephoto lens for all my pictures.

There is no doubt that the highspeed flash will cause as great a revolution in bird photography in India as it has done elsewhere. Photographs of quick-moving birds, like the Bluechat, which always nests on the ground in dark places could not be obtained except by using it. As it does not give dense, hard shadows of the kind usually associated with pictures taken with the 'M' or 'F' type of flashbulb, the results are also more pictorial.

I did not have an opportunity to use colour films with my speedflash but as the light emitted is white in colour, there is no reason why daylight-type colour film should not be used satisfactorily with it.

When technical improvements finally bring decreased weight without decreased efficiency, the use of the speedflash in the high places of the Himalayas will become, as indeed it should be, a problem in photography and not a problem in transportation.

PLATE I

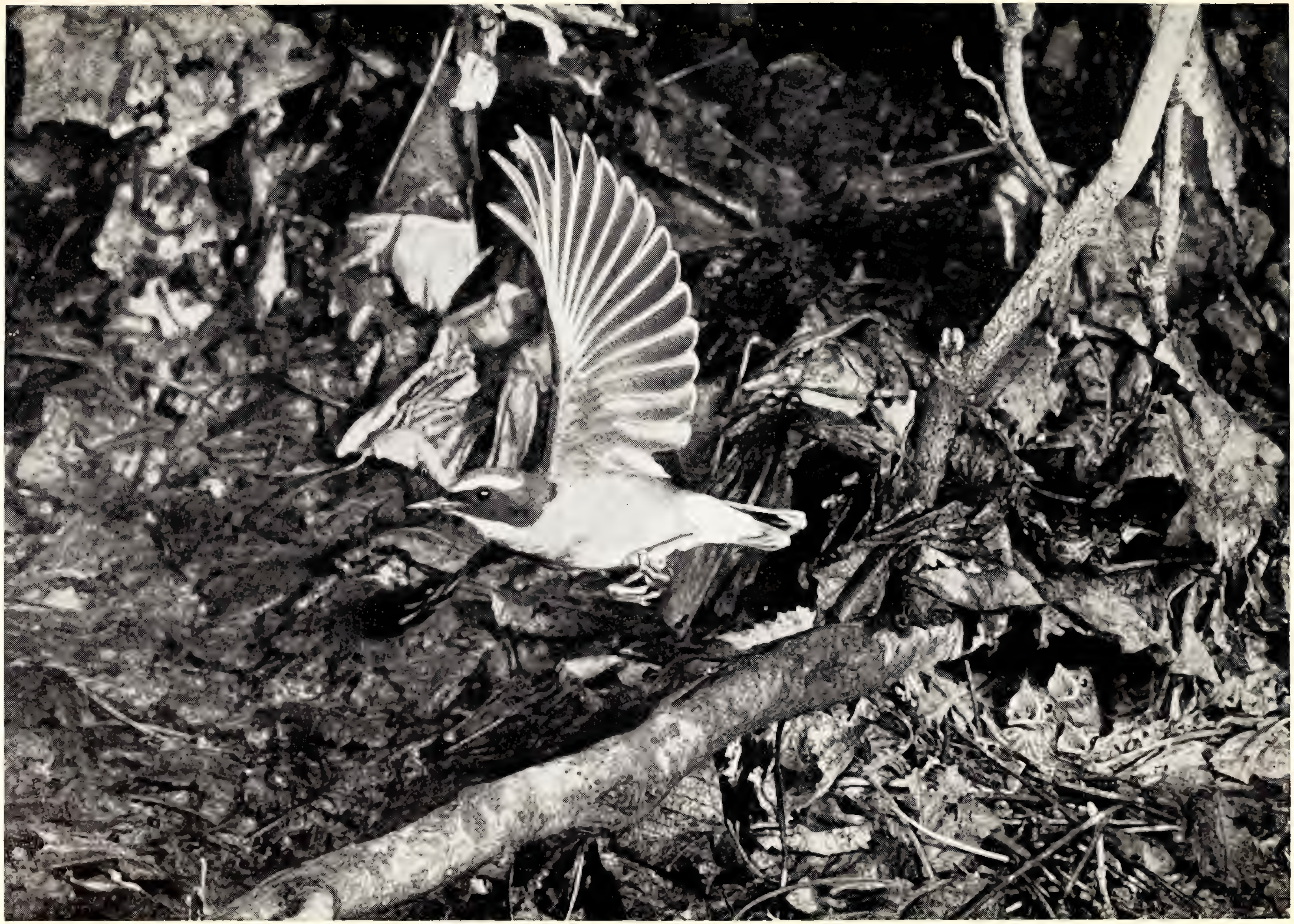


Photo *W. T. Loke* (Speedflash)

Male Bluechat leaving nest

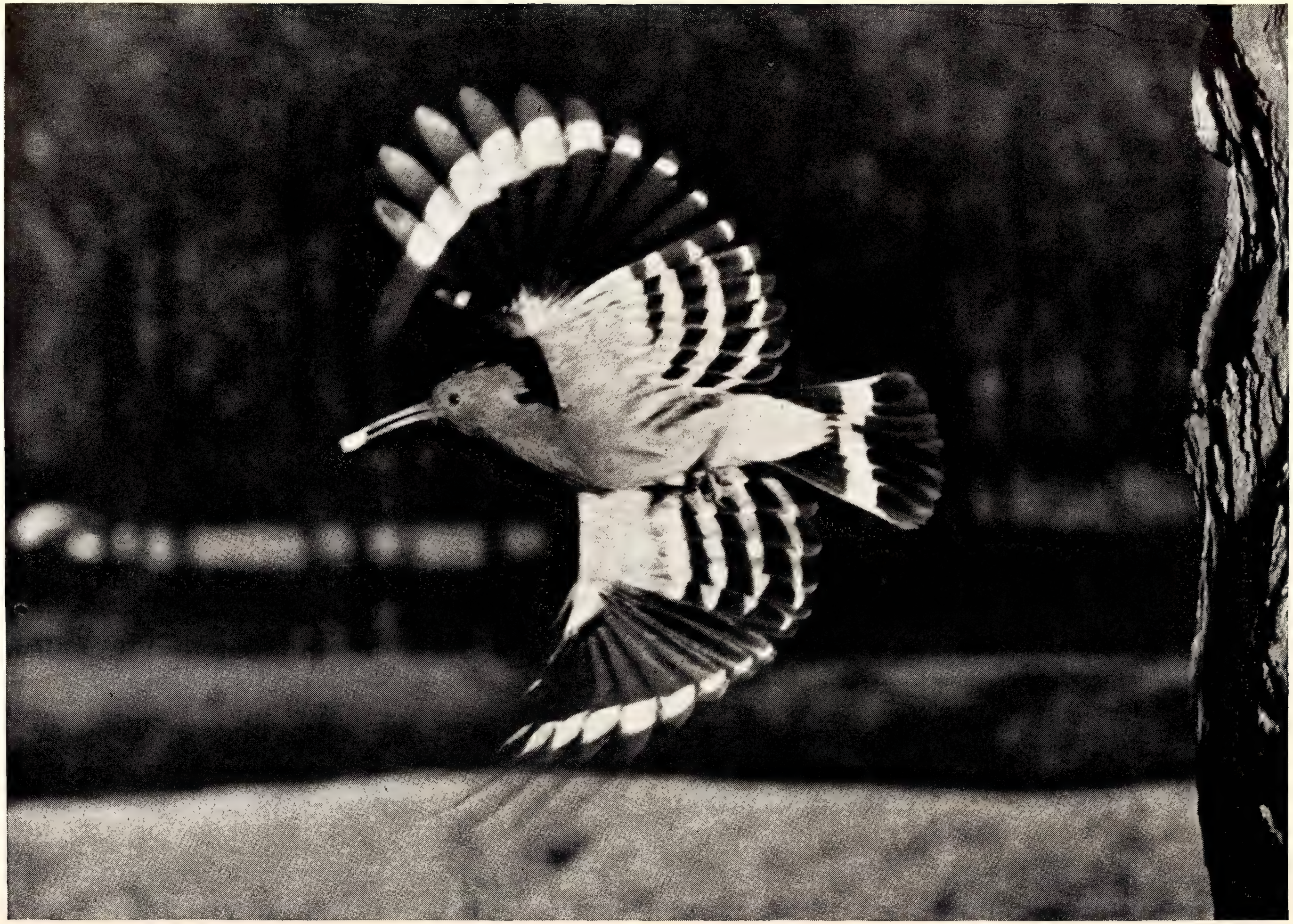


Photo *W. T. Loke* (Speedflash)

Hoopoe (*Upupa epops*) leaving nest with faeces packet of young.

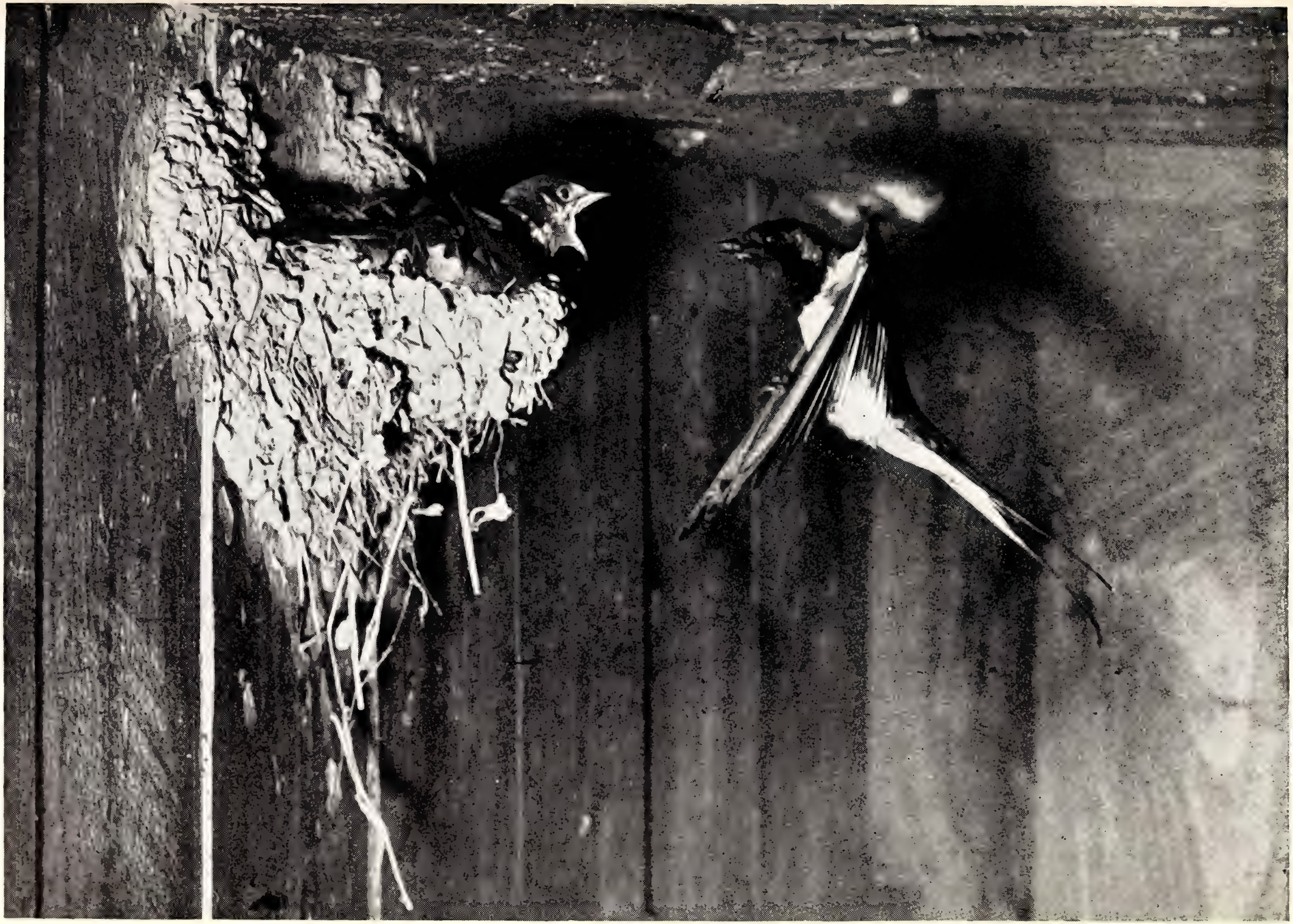


Photo *W. T. Loke* (Speedflash)

Common Swallow (*Hirundo rustica*) approaching nest.
Vale of Kashmir 5,000 ft.

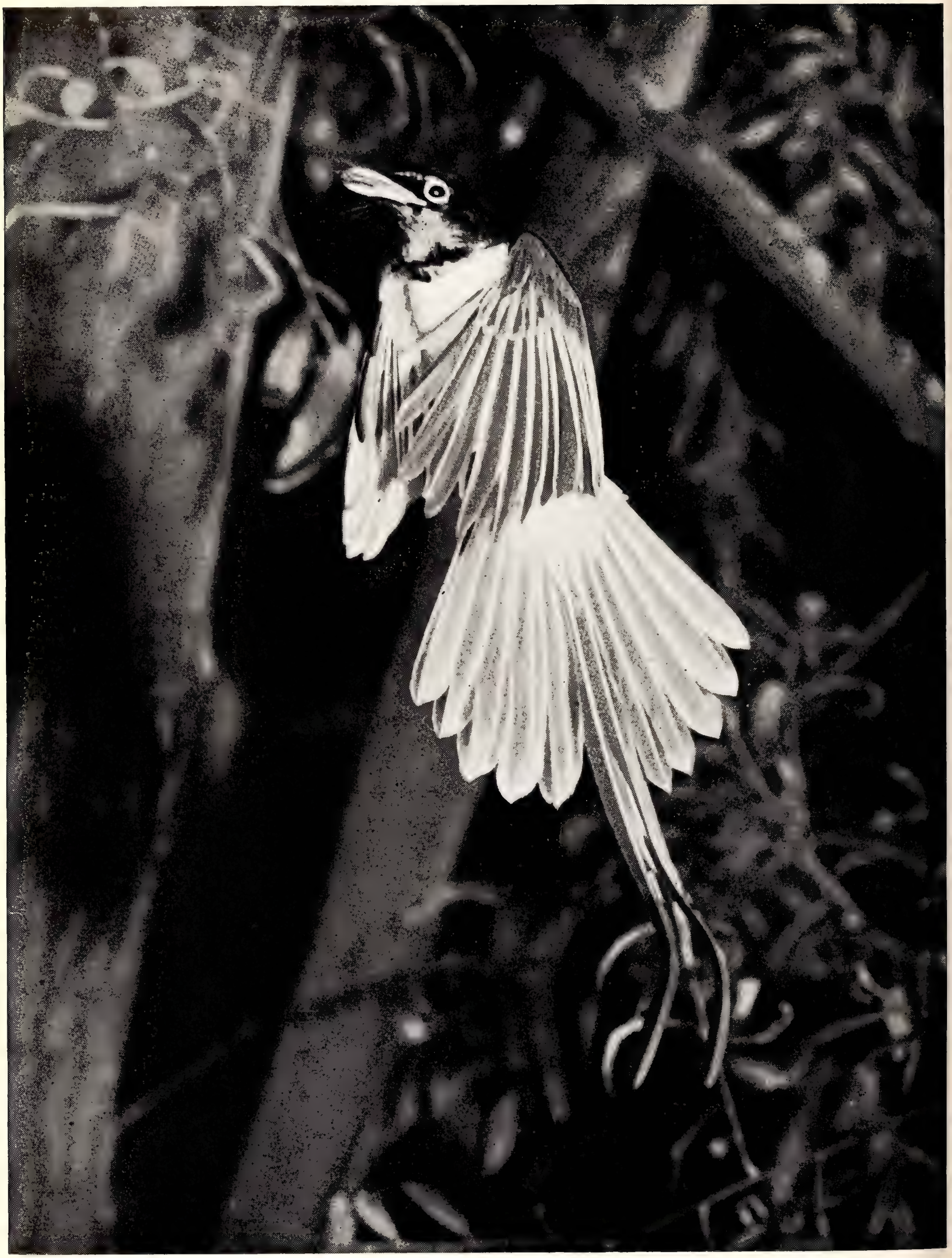


Photo *W. T. Loke* (Speedflash)

Paradise Flycatcher (*Tchitrea p. leucogaster*).
Male approaching nest with food. Anchar Lake 5,000 ft.

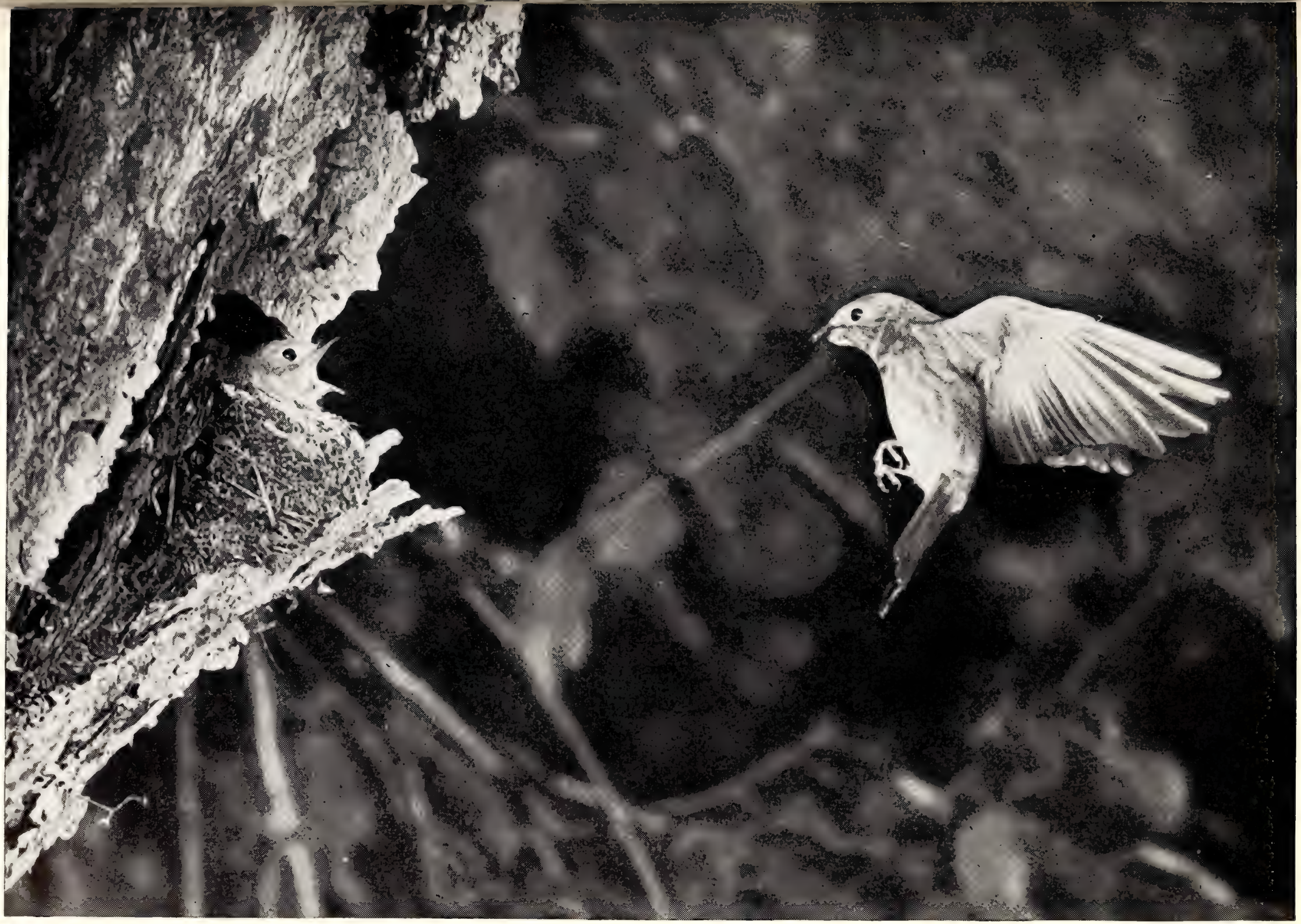


Photo *W. T. Loke* (Speedflash)

Kashmir Sooty Flycatcher (*Hemichelidon s. gulmergi*). The male is about to feed female incubating newly-hatched young. Note food making a lump in the chin. Astanmarg 11,000 ft.

THE GENUS *POA* LINN. IN INDIA

BY

N. L. Bor

Part I

(*With three plates and thirteen text figures*)

Summary

In the Flora of British India the species of *Poa* were worked up by the late Dr. Otto Stapf and in all 17 species were described. Of these, the species called *Poa persica* Trin. has been made the type of a new genus, *Eremopoa* Roshev., by the Russian botanist Roshevitz. The characteristics of *Eremopoa* Roshev. are so different from those of *Poa* Linn., particularly in the nervation of the lemma, that there is no doubt that they are better kept apart. This leaves sixteen species of *Poa* for India.

In the present study, forty-nine species are described, and it is by no means certain that this number covers all the valid species of the Himalaya and neighbouring areas. Some of these forty-nine species have not so far been found within the political boundaries of India and Pakistan, but as they occur just over the border, it may be assumed that they will sooner or later be found within the geographical area known as India, since there are no natural barriers to their spread.

Introduction

The name *Poa*, from the Greek πόα, πόη, ποίη, grass, herb or fodder, apparently was not used to designate any particular plant until Linnaeus founded the genus *Poa* in his *Genera Plantarum* 20 (1737)*, a genus which appeared in each successive edition of the book with the characteristics unchanged. In the first edition of his *Species Plantarum* 67 (1753), Linnaeus gave binomials to 17 species in this genus, the majority of which still remain in the genus *Poa* as conceived by modern agrostologists. The remainder have been transferred to other genera, e.g. *Eragrostis*, as necessity arose.

The systematic treatment of the species of the genus *Poa* is one of the most bewildering and difficult of taxonomic studies. While many species are clear cut and can be recognised at a glance, there are groups of species about which one can only conclude that their evolutionary history has been so complex that they do not lend themselves to systematic treatment by present taxonomic methods. One cannot rely upon a single character to separate species in such groups, but combinations of more or less variable characters must be used—a procedure, it must be confessed, which often leads to the recognition of species by what is suspiciously like guesswork, even if it is termed experience or intuition.

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* In the first four editions of this work, Linnaeus refers to the *Agrostographia* of Scheuchzer, published in 1719, for illustrations of the genus *Poa*. By a curious error, which remained undetected through four editions of the *Genera Plantarum*, Linnaeus quotes tabula IV, fig. 17, instead of tabula, III, fig. 17. In the sixth edition of the *Genera Plantarum*, published in 1754, Linnaeus drops all reference to Scheuchzer, since, as he tells us in the preface to the edition, 'citationes auctorum pro determinandis speciebus expunximus', since these are to be found in *Species Plantarum*, 1753.

The foregoing statements do not apply to the Indian species of *Poa* only, but have been the experience of all workers in this field, no matter what flora has been the subject of their studies. One of the reasons for these difficulties is presumably hybridization and polyploidy followed by apomixis. This suggests that the only satisfactory way of dealing with such difficult groups will be by experimental analysis.

So far no experiments of this kind have been undertaken with any of the Indian species and it seems as if these experiments are far distant. This, however, should not be a valid reason for postponing a revision of the genus in India, for, no matter how difficult and complex the study is or how desirable a knowledge of the genetic basis for each species may be, there are still collections to be named.

Until all the data necessary to give the complete picture have been obtained, the taxonomist must do the best he can with the material at hand. At any rate we are very far from the stage in our knowledge of the genus *Poa* about which Stebbins (1950) surmises ' when this genus is better known, it may have to be regarded as a single huge polyploid complex, which is in part purely sexual, in part facultatively apomictic, and which contains in addition obligate apomicts '.

Difficulties of classification in default of breeding experiments and analysis have so far been tackled in adjacent areas (India and Russia) in two ways, neither of which is entirely satisfactory. The first method is to widen the characters of certain species to such an extent that these species become a kind of dustbin to which many of the aberrant or doubtful specimens can be relegated.

In this method the concept of a species of *Poa* may include characters which are as divergent as firm and herbaceous lemmas, wool or no wool, keels of the palea which are scabrid or ciliate, anthers large or small, ligules long or short, and so forth.

Such a hypothetical species becomes a polymorphic assemblage with extremes looking as different from one another as only two distinct species can. For typical examples of this method, one had only to look at the treatment of the two species *Poa nemoralis* Linn. and *P. annua* Linn. in the *Flora of British India.* Now, if the ambit of *P. nemoralis* Linn. is extended to include specimens with a long ligule and lower glumes which may be lanceolate, oblong-elliptic or even ovate in shape, it is quite clear that *P. nemoralis* as understood by Linnaeus will be swamped in the flood of specimens which obviously look different but which, thanks to the widening of the characters, fall pat into the artificial and capacious receptacle created for them.

In the folders of Indian *P. nemoralis* at Kew, Edinburgh, Calcutta and Dehra Dun were to be found a small number of sheets only which could actually be identified as true *P. nemoralis* Linn. The erection of var. *ligulata* Stapf permitted numerous sheets of *P. sterilis* M.B., *araratiea* Trautv. and several other species to be included.

The treatment of *Poa annua* Linn. in the same work is just as unsatisfactory. This cosmopolitan species is usually a lax annual, sometimes biennial, but very rarely perennial—there is little or no wool at the base of the lemmas—the lemmas are herbaceous, green, with cilia on the keel and outer nerves—the paleae are ciliate on the keels—the anthers are almost 0·8 mm. long. The erection of two varieties, var. *nepalensis* and var. *sikkimensis* in the *Flora of British India,* widens these characters so that the *Poa annua* of India is annual or perennial, with wool or without wool, with keels of the palea ciliate or ciliate below and scabrid above, with lemmas very firm or herbaceous, with all nerves ciliate or only the outer, with anthers varying in length from 0·4 mm. to 2 mm. Into the hypothetical species possessing these characters it is possible to fit *P. annua* Linn., *P. supina* Schrad., *P. infirma* H.B.K., *P. nepalensis* Wall. and *P. sikkimensis* Bor, all of which differ in morphology, habit and appearance, and some even have different chromosome numbers.

The second method is to take a single character as a basis and to divide the species of the genus into two parts on the criterion of its presence or absence. The most frequently used character for this initial subdivision is the nervation of the lemmas. In one group the nerve between the lateral and keel nerves is extremely prominent, while in the other group it is very faint. Each of the two divisions so obtained could again be subdivided by taking another character, say, wool or no wool at the base of the lemma. Further subdivisions would demand other contrasting characters. In this way a rigid dichotomous key is obtained and this is the method, one feels, that has been followed in the *Flora U.S.S.R.* Vol. 2. for in the treatment of the genus *Poa* in that book, which incidentally runs to 106 species, the species are separated in the key on just such characters as the above. If the dichotomy in the key is based upon contrasting characters which are not absolutely reliable, then the whole system breaks down and makes the determination of species by means of a key impossible. In the absence of data obtained by experimental techniques the writer of this paper feels that an intermediate position between the two extremes is in the circumstances the best course to pursue. By this means the unreasonable expansion of the limits of the species, and hence the inevitable lumping, on the one hand, is avoided, and, on the other, that while due regard is given to the status of recognisable species, excessive splitting on doubtful characters is likewise excluded.

The procedure however does not solve the question of the treatment of the more difficult groups, and the writer has come to the conclusion that it is quite impossible to deal with the members of such groups by the ordinary classical methods, but that species must be lumped to be dealt with later when, by breeding experiments, the exact relationship of the members of the group can be elucidated.

Taxonomic Characters and their Reliability

Before any key to a genus can be drawn up a decision has to be made regarding the characters to be used for the separation of species. And after the selection of such characters has been made, further consideration must be given to the confidence or weight which can be placed in these characters.

Such decisions can only be made after experience has been gained by the examination and dissection of a large mass of material. To this end the collections of the genus in the great herbaria of England, India, Paris and Holland have been examined, particularly those of the Royal Botanic Gardens, Kew ; the British Museum (South Kensington) ; the Royal Botanic Gardens, Edinburgh ; the National Botanic Gardens, Calcutta ; the Forest Research Institute, Dehra Dun ; and the Rijksherbarium, Leiden. After examination of this very large mass of material, one is forced to the conclusion that, in so far as the genus *Poa* in India is concerned, there is no single character which can be selected (except possibly one) in which absolute reliance can be placed. The degree of reliability also varies. Some characters are almost always present, others fairly constant, while others only occasionally can be found. The one exception to which reference has been made is the possession of scaly rhizomes. I have yet to find a specimen of *Poa pratensis* which does not possess this organ. But here again it is often missing in herbarium specimens, though usually the remains of it can be made out.

The compilation of a key to the species of *Poa* is therefore a matter of considerable labour, and the writer has been reduced to a state of extreme exasperation on more than one occasion by the discovery that the carefully-built edifice has had to be destroyed because one specimen of a species did not possess the vital character. The fact of the matter is that groups of characters have to be used, and this method, in a dichotomous key, means the repetition of species in the contrasting sections.

In the following pages an attempt is made to list and evaluate characters for diagnostic purposes in the light of experience gained from the examination of the material at hand.

Colour

Although species of *Poa* exhibit many different shades of green, it is difficult to make use of the variations since they are often partly due to habitat conditions. Another difficulty is that of conveying in words the exact description of a shade of green. Still it is possible to make a limited use of colour differences. As, for example, the two grasses, *Poa litwinowiana* Ovcz. and *P. koelzii* Bor, can be picked out at once because of their extremely glaucous aerial parts. As for shades of green, *P. annua* Linn. is light green, *P. compressa* Linn. has a bluish tinge in the green and *P. pratensis* Linn. is said to be dark green in colour.

Some species are much paler and *P. sterilis* M.B. is one such, while its close relative *P. araratica* Trautv. is equally pale but has a reddish or purplish shade in the basal sheaths.

P. tibetica Munro is distinguished by its very pale spikelets, while the spikelets of many of the other species which grow at high altitudes are suffused with purple. But this purple colour, although it usually can be correlated with high altitudes, is too variable to be of any value as a diagnostic character. Other species, again, have bands of gold or orange near the tip of the spikelet and this is sometimes of limited value in diagnosis.

Vegetative Characters

ROOTS

The dense fibrous shallow roots of the species of *Poa* vary so much in appearance and size in response to habitat conditions that no reliance can be placed upon them for diagnostic purposes.

SHOOTS

In addition to the vertical vegetative shoots which usually end in the inflorescence, the genus *Poa* has two types of horizontal modified shoots : underground shoots or rhizomes and stolons which creep over the surface.

CULMS

In most species the culms are terete and smooth but some are scabrid below the panicle, and this is taken in some floras to be diagnostic. While in some instances the scabridity is of such a degree as to be noticeable to the touch, it is usually much less apparent. Seen under a lens, however, it is safe to say that a large proportion of species are at least minutely scabrid below the inflorescence, where the scabridity takes the form of very minute, well-spaced teeth on the nerves.

In one species only, *P. compressa* Linn., is the culm markedly compressed. This is of diagnostic importance in the field, but in a pressed herbarium specimen the character is lost or masked.

STOLONS

P. trivialis Linn. is strongly stoloniferous, the prostrate stems creeping widely, rooting at the nodes and sending up flowering shoots. *P. nemoralis* Linn. is a species that is weakly stoloniferous.

RHIZOMES

The possession of these organs is a most reliable feature and is quite characteristic of the group into which *P. pratensis* falls.

Poa alpigena has a characteristically curved underground stem which is very constant and distinguishes at once living and herbarium specimens from other species.

Poa araratica possesses a striking rootstock, really a thick rhizome with very short nodes, but it is rarely present on herbarium sheets as, when carelessly collected, the culms of this species break off easily at the base, and the rootstock is left in the ground. The culms grow closely crowded together arising from the short, stout, inclined or almost horizontal rootstock which is quite characteristic and which, if present, separate this species at once from the closely related *Poa sterilis* M.B. with which it is often confused. The latter does not arise from a rhizome of this kind, and the circumstance emphasises once again the necessity for careful collecting if correct identifications are to be made.

The two species *P. himalayana* Nees and *P. stewartiana* Bor are very close together: the former possesses a rhizome while the latter does not. They are easily separated on this feature alone.

Appendages to the Vegetative Shoots

SHEATHS

The firmly compressed sheaths of *Poa compressa* Linn. are characteristic, but then the sheaths are more or less compressed in most species, and when dried specimens are being examined no reliance can be placed on this character.

The scabrous sheaths of *Poa trivialis* Linn. are often considered to be diagnostic, but the character breaks down in the form of this species which has smooth sheaths! Indeed, in many species the sheaths are more or less scabrid and the roughness is very variable in amount, even in the same species.

In the series *Bulbosae* the swollen leaf bases, which give the base of these plants a bulbous appearance, are quite distinctive. The grasses which form this group can be separated with confidence from other *Poae* by the possession of this character alone. The bases of the sheaths of non-flowering shoots of these species become thickened and succulent, and act as storage organs where starch and reserve cellulose can be accumulated.

In *Poa alpina* Linn. the basal sheaths decay very tardily, so that the base, consisting mainly of dead and partly disintegrated sheaths, becomes thicker and thicker. Loose, scarious, smooth sheaths are characteristic of *P. pagophila* Bor, *P. hirtiglumis* Stapf and *P. polycolea* Stapf.

The basal sheaths of *P. araratica* Trautv. are distinctly reddish-purple in colour, though this does not hold good for every specimen. The colour is absent in the specimens of the closely related *P. sterilis* M.B.

LIGULES

The length of the ligule is an important and often diagnostic feature, and there appears to be little variation in ligule-length within a single species.

The range within the Indian species is considerable, varying as it does from practically none to 7 mm. long.

At one end of the scale are *P. nemoralis* Linn. and *P. khasiana* Stapf. In the former the ligule is very short, often practically absent and never more than 0·5 mm. long. In the latter it is longer, but still not more than 1 mm. long. At the other end of the scale are *P. pagophila* Bor, *P. lahulensis* Bor, and *P. jaunsarensis* Bor—which have ligules over 5 mm. long.

Most ligules are truncate or rounded on the upper margin and become lacerate with age. The ligule of *P. trivialis* Linn., however, ends in a more or less sharp point, a feature which is diagnostic, provided other essential characters are present.

The texture of the ligule varies from hyaline to membranous or chartaceous, and it is sometimes milky or brownish in colour. The outer surface of the ligule is sometimes scabrid, but this scabridity is so variable as to be worthless as a distinguishing character. In the descriptions of the species the ligule-lengths recorded are those of the ligule of the topmost leaf.

LEAVES

The leaves in the genus are mostly linear in shape, tapering abruptly to a point which is hooded like the prow of a boat. But this characteristic is not uniform throughout the genus, for the leaves of *P. trivialis* Linn., *P. gammieana* Stapf and *P. palustris* Linn. end in a long acuminate tip which is quite different from that just mentioned. The texture of the leaves may be firm or flaccid, they may be green or even pale green, or glaucous or variously suffused with purple. The leaves of all species are folded in the bud.

It is a moot point whether the size and texture of the leaves can in general be taken as reliable characters in the separation of species since these depend so much upon habitat.

In one instance, however, two species very much alike in other respects, can be separated with certainty on the width of the leaves. These two species are *Poa pratensis* and *Poa angustifolia* in which the leaves are much smaller and narrower in the latter than in the former—a circumstance which makes the two grasses look very different in the field or in a herbarium specimen.

The margins of leaves and their surfaces are usually smooth, though asperities can be made out with a lens. Feinbrunn* makes use of this scabridity as an additional character by which *Poa sinaica* Boiss. can be separated from *Poa eigii* Feinbrunn, the latter being scaberulous on the margins of the leaves only, while the former is scaberulous on the surface and on the margins. Whether this difference is a constant feature in all leaves of the two species, or in any way reliable, is open to question. In *Poa asperifolia* Bor, however, the leaves are so scabrid to the touch that the scabridity alone is almost sufficient to determine the species.

Leafiness, or the reverse, is so difficult to define precisely that no matter what conception the worker on *Poa* has in his own mind, it is perhaps better not to try and use it as a contrasting character. Yet, looking through a series of folders, one does get the idea that, compared with others, some *Poae* are distinctly leafy. For example, long lax leaves are found in *Poa trivialis* Linn., *P. nephelophila* Bor, *P. khasiana* Stapf, *P. nemoralis* Linn., *P. nepalensis* Wall., *P. tibeticola* Bor, and *P. aitchisonii* Boiss. Other species, *Poa sterilis* M.B. and *P. araratica* Trautv., for example, are decidedly less leafy.

The arrangement of leaves is a somewhat better criterion. Numerous flat basal leaves with very short culm leaves are characteristic of *Poa alpina* Linn. and *Poa aitchisonii* Boiss. The leaves of the former often turn purple when dried. The mature basal leaves are folded in *Poa tibetica* Munro and flat in *P. alpina* Linn.

The leaves of the sterile shoots at the base of tufts of *Poa bulbosa* Linn., *Poa sinaica* Steud. and *P. bactriana* Roshev. are very flexuous and threadlike, giving a very distinctive facies to the tuft.

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[*] Kew Bulletin, 1940, 277 (1940).

The leaves of *P. infirma* H.B.K. are extremely thin, almost translucent and far thinner than those of any other Indian species.

Inflorescence

PANICLE

The shape of the panicle and its density are important for classification. Most densely spiculate panicles do expand a little as they grow older, but even so they retain their character and are not likely to be mistaken for the effuse wide-spreading panicles common in the meadow grasses.

The length of the pedicel and the branches are important in this respect, as even an expanded spicate inflorescence will retain its densely arranged spikelets.

The number of basal branches is important, and is usually fairly constant. If a species which normally has five basal branches appears to have two or three only it is well to examine the node carefully. Traces will nearly always be found of the missing branches which can be made out as aborted or fused remnants.

THE SPIKELET

The spikelet consists of glumes, lemmas, paleas, rhachilla, androeceum, gynaeceum and lodicules—each of which will be considered in turn.

First of all, the shape of the spikelet may be characteristic. *P. alpina* Linn., in which the glumes and lemmas are curved on the back, has broadly ovate spikelets, and can be recognised by the spikelet alone. On the other hand, there are numerous species in which the keels of glumes and lemmas are more or less straight, and these have spikelets which are cuneate or oblong-cuneate in shape. In between these two extremes there is a gradual transition from one to the other.

(1) THE GLUMES

The lower glume is usually smaller and narrower than the upper. The upper is invariably 3-nerved, the lower 1- or 3-nerved. The nervation of the lower glume is more or less constant for the species. The size of the lower glume and its relationship to the other parts of the spikelet is sometimes diagnostic. For example the two species *Poa himalayana* Nees and *P. stewartiana* Bor, are very close to one another. If, however, the spikelets of each are examined, it will be seen that the tip of the lower glume reaches beyond the centre of the keel of the lowest lemma in *Poa stewartiana* Bor, while in *Poa himalayana* Nees the tip of the glume does not reach so far up. Knowledge such as this obviates the necessity for dissection, and an examination of the palea.

In some species the tip of the lower glume exceeds the tip of the lowest lemma in the spikelet. This is an important taxonomic character and only a few Indian species possess it.

The glumes are usually narrowly hyaline on the margins, but in *Poa glabriflora* Roshev. they are curiously translucent, and the bases of the lemmas can be seen through them.

The shape of the lower glume is a good character. Those of *Poa* *nemoralis* Linn. and of *P. setulosa* Bor are awl-shaped, that of *P. alpina* Linn. ovate when flattened; others are (and this includes the majority of the species) lanceolate or elliptic-acute when flattened.

(2) LEMMA

The grass flower arises in the axil of a scale-like bract or leaf, the lemma, and is enclosed between it and the bracteole or palea. Thus these two scales are in close contact with the most important part of the plant and therefore intimately concerned with its protection. As might be expected these organs show less variability than any others.

In all species the lemma is more or less keeled. In *Poa palustris* Linn. the lemma is sharply keeled below and not above, so that in the fruit the lemma is flattened on the back.

In *Poa calliopsis* Litw. the lemma is more rounded than keeled and is reminiscent of the lemmas in the genus *Colpodium*.

(a) *Colour*

Colour is hardly a reliable factor, but glaucous spikelets are found in *Poa litwinowiana* Ovez. and *P. koelzii* Bor. For the remainder, which possess spikelets of various shades of green, an infusion of purple in the lemma seems to be correlated with habitats at high altitudes. Possibly the colouring matter is a protection against the penetrating rays of the sun in the rarified air of the highest mountain tops. In some of the species which live at high altitudes the purple lemma is divided from the hyaline margin at the tip by a band of golden coloured tissue which makes the spikelet an object of great beauty. A faint yellow band is often present between the hyaline tip of the lemma and the lower green or violet portion.

This can easily be seen in *P. sterilis* M.B., *Poa nemoralis* Linn., *Poa pratensis* Linn. and others. In *P. palustris* Linn. the colour of the band is coppery or orange, but is not always so distinct as to be diagnostic.

(b) *Nervation*

All the lemmas of species of *Poa* have five nerves, the centre one being the keel nerve, about which the lemma itself is folded or compressed.

The texture of the lemma varies within wide limits, though it is constant for a species. Most lemmas tend to become indurated or at least firmer as the seed ripens, and this fact is a point to remember when making use of a character which has been used for a very long time to divide the species into two categories. The section *Pachyneurae* Aschers. contains those species of *Poa* in which the nerve between the keel and marginal nerves on each side is prominent and conspicuous. The other section is the *Leptoneurae* Döll, in which the corresponding nerves are faint and inconspicuous. This subdivision is reasonably satisfactory as long as the lemmas are young. When older, however, the conspicuous intermediate nerve of species in section *Pachyneurae* tends to become inconspicuous as the lemma becomes firmer, so that the significance or reliability of this character becomes masked. Nevertheless this is a very useful subdivision and one which is made use of in many floras.

Personally, I think it can be best applied as an additional—not as a primary—distinguishing character.

(c) *Surface*

The surface of the lemmas in most species of *Poa* is dull and mat, and while they may not be actually scabrid, they are granular in appearance under a lens. The surface actually looks as if it were pitted and glandular. Under a higher power it becomes clear that the granular appearance is due to the numerous silica cells in the epidermis of the lemmas. These are much more numerous in some species than in others. For example, in *P. pratensis* Linn., *P. angustifolia* Linn., *P. wardiana* Bor and others, these silica cells are very numerous, and give a dull appearance to the lemmas which are markedly different in appearance and texture from the shining lemmas of *P. alpina* Linn., *P. lahulensis* Bor and *P. tibetica* Munro in which the silica cells are not so numerous.

Some species are distinctly scabrid on the dorsal surface, not only on the upper parts of the nerves and keel, but on the actual surface between the nerves. *P. wardiana* Bor, *P. gamblei* Bor, and *P. pagophila* Bor may be mentioned as examples of this.

The covering of matted hairs, white or yellowish, which is to be found on the lower half of the lemmas of some species is very remarkable. This feature is a good diagnostic one, but it must be looked for carefully since the short matted hairs are caducous, and in mature spikelets very often all but the barest traces are lost. In *P. hirtiglumis* Stapf, one of this group, the hairs are golden yellow in colour and comparatively long, and are appressed to the surface of the lemma. All the species which possess this feature are high altitude plants, and it is possible that the felty covering serves a useful purpose as an insulating device to protect the androeceum, gynoecium and seed against violent fluctuations of heat and moisture.

Other appendages which are found on the lemma are—(*a*) the ciliate hairs on the nerves, and (*b*) the wool on the callus at the base. First of all it should be stated that there are some species which are almost completely devoid of cilia, hair or wool. Such species are *Poa glabriflora* Roshev., *P. bactriana* Roshev. and *P. poophagorum* Bor, and some races of *P. bulbosa* Linn. and *P. aitchisonii* Boiss. are equally bare.

For the rest every combination can be seen—all the nerves, or only the keel and outer pair, or the keel alone may be ciliate. The presence or absence of the cilia on the nerves are good characters and do not vary much within a species.

The keel is rarely ciliate for more than half its length, the upper half being most often scabrid. The nerves are usually scabrid, not ciliate, in the upper third or quarter.

The wool at the base of the lemma, actually on the callus, is a very good and reasonably reliable character, but not quite good enough to separate a whole genus into two sections. How far this is a genetic character is of course not known, but in the *sterilis* group, for example, the quantity of wool does not appear to be constant. In *P. sterilis* M.B. itself, wool is not considered to be present, but in certain specimens which can undoubtedly be placed under *P. sterilis* M.B. there is wool present, albeit only a strand or two. In the dichotomous key, therefore, *P. sterilis* M.B. will be found in both halves. Actually to separate species on the possession or absence of wool, as in the *Flora of the U.S.S.R.*, seems to be a dangerous procedure.

The wool on the callus and the cilia on the nerves appear to consist solely of 1-celled hairs.

(3) PALEA

This organ is one of the most important in the grass flower. Morphologically it is the bracteole which is situated between the flower and the rhachilla and is homologous with the prophyllum. Typically the palea is 2-nerved, the nerves being separated by a thin sheet of hyaline tissue which is concave on the adaxial surface. Outside the two nerves are two flaps, both being thin and hyaline. This structure suggests very strongly that its shape and nervation are due to space conditions within the developing spikelet. At any rate the two flaps are pressed against the margins of the lemma and the surface between the nerves against the rhachilla, so that the palea is strongly 2-keeled. The rôle of the palea seems to be a protective one. The hyaline tissue between the keels is sometimes granular from the presence of silica cells, and 1-celled hairs may or may not be present in addition on the adaxial surface. These surfaces may also be very scabrid as in the species *P. wardiana* Bor.

By far the most interesting and important, however, are the appendages to the keels. The keels are invariably armed with either forwardly directed teeth or hooks or spreading 1-celled hairs, the upper half bearing teeth and the lower half cilia.

In the species *Poa calliopsis* these teeth are reduced to a few blunt projections on each keel, but the teeth are numerous and in one or more rows in all the other species except those in which the keels are completely ciliate. For this one species the reduced number of teeth constitutes a diagnostic feature.

Von Oettingen has attempted to use the armature of the palea keels as an additional tool in the identification of species.

After the examination of a large number of specimens he formulated a scheme the salient features of which are as follows :—

He distinguished four groups.

(1) *Pilosae* in which the keels are ciliate from base to apex with longish hairs.

(2) *Semi-pilosae* in which the lower half of the keel is ciliate with the cilia passing insensibly to the teeth above.

(3) *Dentatae* in which there are no hairs but more than one row of hooked teeth.

(4) *Pectinatae* in which the teeth are reduced to a single row on the keel.

In the writer's opinion the possession of hairs, teeth or a mixture of both is of such importance in the identification of species of *Poa* that it is worth while taking some trouble to find out exactly how these structures are arranged.

The palea to be examined should be placed in a drop of water and the keels carefully examined. In young paleas the hairs, if present, are not immediately apparent, and indeed it may be necessary to tease them out. In older paleas the hairs are motile and stand out at once.

These hairs or trichomes are reduced in number or almost entirely aborted in some races of those species in which they are normally present. This sometimes happens in *Poa annua*, one of the commonest of species. It has been found, however, that the hairs are not altogether absent though they may be reduced in extreme instances, to a single trichome. In specimens which exhibit a palea with few or no trichomes on the keels, it is reasonable to search for the species among those listed under *Pilosae* below. In specimens in which the upper part of the keel of the palea is covered with hooks and the lower half bare or almost bare, the species should be sought for under *Semipilosae*. In both these categories there are additional subsidiary characters, which help to separate the species easily.

Apart from such aberrations, experience has shown that the armature of the keels of the palea, when hairs are present, is a very great help towards identification, but that von Oettingen's other two sections are of limited value only.

The writer's opinion is that to attempt to divide all the species which have scabrid keels into two rigid classes, according as they have one row of teeth (*Pectinatae*) or two or more rows (*Dentatae*) is a matter of some difficulty. For, while it is admitted that some can be relegated to one or other category with ease, there are others which appear to occupy an intermediate position. For example, it is quite evident that *P. angustifolia* Linn. has one row of teeth, and that *P. palustris* Linn. has more than one. But it is not so easy to place *P. compressa* Linn., which appears to have teeth in one or more rows.

The following is a list of those species which belong to the sections *Pilosae* and *Semi-pilosae*.

Pilosae

A bare half dozen species belong to this group. They are *P. annua* Linn., *P. hirtiglumis* Stapf, *P. infirma* H.B.K., *P. nepalensis* Wall., *P. supina* Schrad., *P. nephilophila* Bor.

Semipilosae

To this group belong *P. alpina* Linn., *P. burmanica* Bor, *P. gammieana* Hook. f., *P. stapfiana* Bor, *P. stewartiana* Bor. An interesting, but idle, speculation is that these species are fertile hybrids between species in *Pilosae* and species in *Dentatae-Pectinatae*. If this be so, there is no method of telling in our present state of knowledge what the parents may be.

(4) RACHILLA

The rachilla in the genus *Poa* is slender and terete and jointed below each floret. It is always prolonged beyond the upper perfect floret and crowned with a rudimentary lemma and palea. The internodes are attached to the base of the adjacent lemma, and the internode and floret fall together when the rachilla breaks up.

The shape of the spikelet depends very largely upon the lengths of the internodes of the rachilla. The compact lanceolate or ovate types are those in which the joints are very short. On the other hand the oblong, loose types are those in which the florets are well spaced. The rachilla joints (internodes) are much longer in *P. nephelophila*

Bor. and *P. polycolea* Stapf than in any of the remainder of the Indian species.

The rachilla is smooth and glabrous in about half of the Indian species, while in the remainder it is shortly hairy, verrucose, or covered with scabridities. It is not possible to use these features to any extent in the separation of species.

THE FLOWER

In the majority of the Indian species of *Poa* all the florets in a spikelet, excluding the terminal rudimentary floret, are usually hermaphrodite, but in one of the commonest Indian species, *Poa annua* L., the lower florets are hermaphrodite, while the upper one or two are female. This arrangement is quite unusual in the genus.

(a) *Androeceum*

The androeceum consists of three stamens, each of which has a long filament surmounted by an anther with 2 loculi opening by longitudinal slits. The size of the anthers does not vary to any extent within a species, except in one known instance, as will be seen later. In so far as the genus in India is concerned, the smallest anthers, 0·22 mm. long, are found in the species *Poa infirma*, and the largest, 3 mm. long in *Poa falconeri*, *P. ludens*, *P. pagophila* and *P. palustris*.

As had been indicated, the size of the anthers is a reliable character and has been used in the key to separate groups. As might have been expected, however, there is an exception to the otherwise general rule. In *Poa stapfiana* (*P. tremula* Stapf) there is a race in which the only difference from the type is the small anthers. Stapf called the variety var. *microtheca* and it is the sole example of a marked variation in the size of the anthers within a species. The peculiarity has of course been allowed for in the key.

As in the majority of species the anthers are bright yellow, but purple anthers and yellow anthers spotted with purple are not unknown, especially in the high altitude species.

(b) *Gynoeceum*

The gynoeceum consists of a one-celled ovary with two styles and two plumose stigmas. There is a single ovary attached to the wall of the carpel.

(c) *Lodicules*

The lodicules are two in number and are more or less 2-toothed or -lobed.

(d) *Grain*

The hilum is punctiform and basal.

Cytology and Cytogenetics

Avdulov's (1931) pioneer work on the cytology, anatomy and morphology of the grasses has been of great importance to those whose studies include the systematics and phylogenetic relationships of the Gramineae. This original work and research lead him to divide the family into two large groups, *Sacchariferae* and *Poatae*. The latter were again subdivided into *Phragmitiformes* and *Festuciformes.* Both *Sacchariferae* and *Phragmitiformes* have small chromosomes, the former in multiples of 9 or 10, and the latter in multiples of 12. The *Festuciformes,* however, have large chromosomes with a basic number of 7.

When Avdulov came to examine the *Festuciformes* in detail, he found that the vast majority of those included in this group were inhabitants of the temperate or cooler regions of the world. From this and other considerations he propounded the hypothesis that the evolutionary trend in the grasses was towards a reduction in chromosome number but an increase in chromosome size—a hypothesis which has had a large measure of acceptance. He took the view that the phylogenetic increase in size of the chromosomes was brought about as an adaptation to the more rigorous climate in which these grasses live.

In common with most of the genera which inhabit temperate or cold climates, the basic chromosome number in the genus *Poa* is 7. The genus can also be considered to be advanced in that the species, *inter alia,* have specialised appendages in the form of the wool at the base of the lemmas, and often hairy coverings to the lemmas themselves. It is therefore something of an anti-climax to find that the chromosomes in the genus are small, in fact much smaller than in other members of the *Festuciformes.* Stebbins (1950) considers this circumstance to provide the best evidence among plants for the reversibility of trends in absolute chromosome size.

Since no Indian cytologist has worked on the Indian species of *Poa,* the work of Russian, American and British scientists on those species which are cosmopolitan and which are also found in India, has been taken as the basis for the following short account.

Reference may be made to an excellent review of the whole subject by Myers (1947), whose index to the literature contains over 600 references.

Polyploidy is a feature of the Gramineae and the genus *Poa* is one of the genera which provides perhaps one of the best illustrations of this statement.

Not only is polyploidy common in this genus, but several of the species include races which differ in chromosome number, as will be evident from the following list of species, all of which occur in India :—

	2n
Poa annua Linn.	28
P. supina Schrad	14
P. infirma H.B.K.	14
P. bulbosa Linn.	28
P. tibetica Munro	56
P. sterilis M.B.	28, 42
P. nemoralis Linn.	28, 42
P. palustris Linn.	28, 42
P. alpina Linn.	32-34, 42, 22-38, ±31, 22, 23, 24, 25, 31.
P. compressa Linn.	35, 42, 49, 56.
P. pratensis Linn.	28, 56, 70, 49-85, 50-87, ±1, 66, 67, 41± to 64, 48·72, 28-114, 18, 40, 42, ±72.

The most important effect of polyploidy is the genetic barrier which immediately comes into being between a polyploid and its diploid progenitor (Stebbins). Apart from this there are morphological as well as physiological changes about which there is considerable difference of opinion.

Actually it is difficult to generalise about these matters and according to Stebbins the only safe generalization which can be made about morphological and physiological changes as a result of polyploidy is that they depend greatly upon the original genotype !

On the other hand, some authors hold that the alteration in chromosome number from diploidy to tetraploidy and hexaploidy leads generally to an increase in plant and organ size. Any further increase in chromosome number means either no increase in plant size or, in some instances, a diminution.

With regard to ecological conditions and particularly to extreme conditions, there is some evidence which seems to indicate that polyploidy confers certain benefits upon the plant. It is believed by some authors that polyploidy actually means the acquisition of new genetical and morphological characters, whereby the migration of the plant into areas where the conditions for plant life are more exacting, is facilitated.

In areas where drought, insolation, ice and snow are the controlling factors, the proportion of polyploids in the plant population is high. It has been found that in those species in which diploids and polyploids occur, the polyploids prefer a more northern and alpine habitat than the diploids.

As an example the mountains of the Pamir (a continuation of the Karakoram Himalaya through the Hindu Kush) and the Altai (Central Russia) can be taken. Two Russian botanists, Sokolovskaya and Strelkova (1940), found that the proportion of polyploids in the species studied (mostly *Gramineae*) was 85 per cent. for the former and 65 per cent. for the latter. It may be added that the conditions for plant life in the Pamir are far more exacting than in the Altai. Further, in the Arctic, polyploids account for about 80 per cent. of the plants studied by Flovik (1940).

Polyploids, which have arisen as hybrids between races or subspecies of a species, are known to possess a toleration of edaphic and climatic conditions which are greater than those of either of the parents. The same is true of allopolyploids. Such polyploids, then, do possess characteristics which enable them to colonise habitats which are beyond the range of the parents.

Apomixis

Included in this term are proliferation (sometimes called vivipary) and agamospermy. As far as is known no critical investigation has been carried out on proliferation, considered as a form of apomixis, but Arber was of opinion that the number of instances in which proliferation gave rise to new plants must be small indeed. On the other hand the fact that *P. bulbosa* L. is exceedingly common in the Himalaya and that proliferation seems to occur in every inflorescence, it is possible that the production of new plants from viviparous inflorescences is much higher than it is thought to be. At any rate, out of many hundreds of plants seen, only in one case did it appear that the inflorescence was normal. In India proliferation has been noticed, apart from *P. bulbosa*, in *P. alpina* and a dubious case of *P. pratensis*. Among other members of the *Bulbosae* (*P. bactriana*, *P. glabriflora* and *P. sinaica*) this condition does not appear to occur.

Agamospermy is common in the genus *Poa* and extensive studies on this phenomenon have been carried out, especially in the species *P. pratensis* and *P. alpina*. Apomixis was first suspected in *P. pratensis* because parent plants with aneuploid chromosome numbers produce morphologically uniform progenies with the same chromosome number (Müntzing). In subsequent investigations it was shown for *P. pratensis* that there is almost a complete series of forms which range from almost entirely apomictic to completely or almost completely sexual. The cytological basis for apomixis in *P. pratensis* was discovered by Åkerberg (1939, 1942, 1943). It was found that aposporic apomixis took place in which the embryo sac developed from a cell of the nucellus without fertilisation. Generally the products of meiosis degenerated and disappeared and were replaced by the aposporous embryo sac. The development of the embryo is independent of fertilisation but pollen is an absolute necessity before there is any formation of endosperm. One remarkable result of this research was the discovery that the pollen of *P. alpina* can bring about the formation of endosperm equally well with that of *P. pratensis*.

In *P. alpina* meiosis has not been observed in apomictic biotypes, the first division of the macrospore mother cell being mitotic. In this species pseudogamy also occurred. The development of the embryo started without fertilisation, but endosperm development was dependent upon fertilisation of the polar nuclei (Håkansson 1944).

The progeny test, carried out on *P. compressa*, indicates that it, too, reproduces, at least in part, by agamospermy on the same basis as *P. alpina*.

That the cause of apomixis is to be ascribed to genetic factors seems to be indicated by the work of Müntzing (1940). In crossing sexual and apomictic forms of *Poa* he obtained types which were predominantly sexual, showing that apomixis is recessive to sexuality. Hybrids obtained from a cross between two apomictic parents *P. pratensis* and *P. alpina* were themselves sexual. Similar results were obtained when *P. compressa* and *P. pratensis* both highly apomictic, were crossed. In this case both the F_1 and F_2 generations were also sexual.

Classification

It is not the writer's intention to attempt to provide a new system of classification of the subdivisions of *Poa*. No published system has so far been accepted in its entirety, nor is a thoroughly reliable system likely to emerge until there has been a complete study of the genus as a whole, particularly in the field.

What follows is merely a grouping of the species treated in this work into what seems to the writer to be their probable relationships. Since any logical classification must take into consideration the life habit of the species, a characteristic which cannot be accurately or completely deduced from herbarium specimens, it is quite certain that the following proposals will eventually become modified or upset altogether as knowledge of the genus increases.

Until that stage is reached, the following may serve as a basis for criticism, and perhaps provide the stimulus to produce something better.

I. OCHLOPOA

Annuals or caespitose perennials; glumes ± unequal in length, the lower the smaller, 1-nerved, the upper 3-nerved; lemma and glumes mostly thin; anthers usually small; keels of palea pilose, rarely semipilose or scabrid; leaves broad, flaccid, green.

1. *P. tibeticola* Bor.
2. *P. infirma* H.B.K.
3. *P. nepalensis* Wall.
4. *P. nephelophila* Bor.
5. *P. supina* Schrad.
6. *P. annua* Linn.
7. *P. sikkimensis* Bor.
8. *P. stapfiana* Bor.

II. HIMALAYENSES

Slender perennials; glumes unequal; the lower very narrow, 1-nerved, the upper 3-nerved; lemmas conspicuously 5-nerved; wool copious to absent; anthers less than 1 mm. long; keels of palea scabrid, rarely semi-pilose; ligule over 1 mm. long; rhachilla smooth, rarely warty.

9. *P. himalayana* Nees.
10. *P. stewartiana* Bor.
11. *P. khasiana* Stapf.
12. *P. wardiana* Bor.

III. NEMORALES

Slender perennials; lower glume awl-shaped, 1–3-nerved, upper 3-nerved; lemmas hyaline at tip and on the margins; anthers over 1 mm. long; ligules very short, less than 1 mm. long; leaves narrow; rhachilla minutely hairy.

13. *P. nemoralis* Linn.
14. *P. polycolea* Stapf.
15. *P. aitchisonii* Boiss.

IV. SETULOSAE

Tufted perennials; glumes awl-shaped, setulose, 1-nerved, much longer than the lemmas; anthers less than 1 mm. long.

16. *P. setulosa* Bor.

V. STERILES

Caespitose perennials; panicles effuse or contracted; glumes ± equal in length, narrowly or broadly elliptic, both 3-nerved; lemmas indistinctly 5-nerved, hyaline at the tip with usually a yellow band below, rarely silky on the dorsal surface, rhachillas minutely verrucose to hairy.

17. *P. sterilis* M.B.
18. *P. araratica* Trautv.
19. *P. litwinowiana* Ovcz.
20. *P. lahulensis* Bor.

VI. PALUSTRES

Caespitose perennials; glumes thin, subequal, the lower 1-, the upper 3-nerved; lemmas thin, inconspicuously nerved; wool present, often plentiful; rhachilla shortly and minutely hairy; leaf-blades flat, dark green, abruptly tapering to a point.

21. *P. palustris* Linn.

VII. TRIVIALES

Perennials with stolons; glumes small, curved on the back; lemmas firm, distinctly 5-nerved; ligules long, pointed; leaves thin, soft, tapering; sheaths, particularly the lower, harsh to the touch, rarely smooth.

22. *P. trivialis* Linn.

VIII. STOLONIFERAE

Perennials with scaly, long-noded rhizomes; glumes ± unequal, the lower 1-, the upper 3-nerved; lemmas firm, conspicuously 5-nerved; wool usually very copious: keels of palea scabrid; anthers linear, long; leaves rather firm, hooded.

23. *P. alpigena* (Blytt) Lindm.
24. *P. angustifolia* Linn.
25. *P. asperifolia* Bor.
26. *P. jaunsarensis* Bor.
27. *P. pratensis* Linn.

IX. TICHOPOA

Perennials, with extensively creeping rhizomes; stems compressed; glumes ± equal, the lower 1-, the upper 3-nerved; lemmas very obtuse, firm, inconspicuously 5-nerved; wool rather scanty; leaves flat.

28. *P. compressa* Linn.

X. LANATIFLORAE

Perennials; panicles spreading; spikelets large; lower glume 1- rarely 3-nerved, upper 3-nerved; lemmas conspicuously 5-nerved, often broadly hyaline on the margins, hairy on the lower surface in the lower half, rarely only scabrid; anthers generally large; leaves broad to very broad, flat.

29. *P. pagophila* Bor.
30. *P. falconeri* Hook. f.
31. *P. nitide-spiculata* Bor.

32. *P. gammieana* Hook. f.
33. *P. eleanorae* Bor.
34. *P. burmanica* Bor.
35. *P. ludens* Stewart.
36. *P. gamblei* Bor.

XI. GLABRATAE

Densely tufted perennials ; glumes ± equal, the lower 1–3-nerved, the upper 3-nerved; lemmas somewhat firm, almost quite glabrous, shining, with inconspicuous nervation ; wool present or absent ; leaf-blades flat, plicate or very narrow ; anthers minute to 1·5 mm. long.

37. *P. amoena* Bor.
38. *P. poophagorum* Bor.
39. *P. phariana* Bor.
40. *P. rhadina* Bor.

XII. PAUCIDENTATAE

Perennials rhizomatous with basal nodes closely crowded ; glumes and lemmas thin, very broad, rounded or very obtuse, curved on the back ; lemmas obscurely 5-nerved ; paleas with a few blunt teeth on the keels; leaves plicate, tapering abruptly to a stout point.

41. *P. calliopsis* Ovcz.

XIII. ALPINAE

Perennial grasses with basal nodes close together ; spikelets broadly elliptic-ovate ; glumes broad, both 3-nerved, curved on the back : lemmas silky-hairy on the dorsal surface, curved on the keel; keels of the palea semi-pilose, rarely scabrid; leaves flat, tapering abruptly to a point, nearly all collected at the base of the plant.

42. *P. alpina* Linn.
43. *P. hirtiglumis* Hook. f.
44. *P. koelzii* Bor.
45. *P. tibetica* Munro.

XIV. BULBOSAE

Perennials with culms bulbous at the base ; glumes ± equal, broad, the lower 1-, the upper 3-nerved, scarious ; lemmas rather firm, very variable in the matter of cilia and wool ; leaves very narrow, filiform to flat and somewhat rolled.

46. *P. glabriflora* Roshev.
47. *P. bactriana* Roshev.
48. *P. sinaica* Steud.
49. *P. bulbosa* Linn.

POA Linn.

Spikelets 2–7-(rarely 1- or 9-) flowered, in loose, spreading or contracted, sometimes almost spike-like, panicles ; rhachilla disarticulating above the glumes and below each floret, smooth and glabrous or minutely warty or hairy, rarely pilose below, usually continued beyond the topmost floret and crowned by a rudimentary floret; florets hermaphrodite or the upper imperfect. *Glumes* usually shorter than the lemmas, occasionally longer, more or less equal in length, membranous, green or more or less suffused with purple, keeled, acute, acuminate or rarely obtuse, 1–3-nerved, with a broad or narrow hyaline margin, smooth and glabrous or rarely sparsely scabrid on the dorsal surface near the tip, usually scabrid on the upper half of the keel. *Lemmas* varying in texture from thinly membranous to almost coriaceous, obtuse, acute or rounded at the tip, green or suffused with purple, with or without a yellow band below the hyaline tip, keeled, faintly or conspicuously 5-nerved, smooth or more often scabrid on the upper half of the keel, more rarely scabrid on the dorsal surface near the tip or all over, hyaline at the tip and along the margins, ciliate on the lower half of the keel and lateral nerves, rarely on all the nerves, glabrous on the dorsal surface below between the nerves or with a more or less thick covering of white matted hairs in the lower half or all over, very rarely entirely glabrous; often punctate or granular all over the dorsal surface, especially when the lemmas are of firmer texture; *callus* small, obtuse, distinct, often carrying a tuft of long wool. *Paleas* usually shorter than the lemmas, occasionally longer, hyaline, 2-keeled, hairy or glabrous between the keels, punctate or not on the flaps and/or between the keels, dentate, scabrid, spinulose, ciliate, or almost smooth on the keels or scabrid above and ciliate below. *Lodicules* 2, more or less 2-toothed or 2-lobed. *Stamens* 3; anthers very minute up to 3 mm. long, purple or yellow. *Ovary* glabrous; styles short, distinct; stigmas plumose, laterally exserted. *Grain* linear, free or adherent to the palea. *Hilum* punctiform, basal.

Annual or perennial grasses, the latter with rhizomes or stolons or both. *Culms* terete or rarely compressed, erect or decumbent below, sometimes with a bulbous thickening at the base, often densely tufted, smooth or scabrid beneath the panicle. *Leaf-blades* flat and flaccid or firm, sometimes plicate or convolute and threadlike, smooth or scabrid, often abruptly contracted to a firm scabrid tip or hooded; *sheaths* smooth or scabrid; *ligules* hyaline to membranous, pointed to rounded, lacerate or entire, almost absent to 7 mm. long, occasionally scabrid on the outer surface. Panicle branches often whorled or single, usually scabrid, rarely smooth; pedicels always scabrid.

This genus is a large one of well over two hundred species which are world-wide in distribution. The species are found in all temperate or cold climates, irrespective of whether these climates are due to geographical position or high altitude. A few species are cosmopolitan. In the Himalaya the vertical limits between which species of *Poa* are found, is 800 m. to 6,500 m.

How to use the key

The characters by which the individual species are separated are duration of life, habit, shape and size of the spikelets and their separate parts and the nature of the keels of the palea. It has not been found possible to draw up a key containing only characters which are visible to the naked eye—a lens and dissection are necessary to be certain of a correct determination. Those who spend months on the genus, do, with time, acquire a certain facility in separating the species by eye, but the systematist who wishes to name a collection or a single specimen cannot be expected to know all the species by sight.

The grass to be identified must first of all be carefully examined in order to find out if there is a bulbous thickening at the base or not. Is the plant a perennial or annual, is it tufted or does it possess stolons or rhizomes, or both? Find out if the culm is smooth or scabrid below the inflorescence and if it is terete or compressed. Are the lower sheaths smooth or scabrid? Measure the length of the ligule of the *topmost* leaf. Before dissection of the spikelet, there are two things to find out (*a*) the shape of the spikelet—is it ovate or some other shape? and (*b*) the position of the tip of the lower glume in relation to the mid-point of the lower lemma as it is in the untouched spikelet. Find out whether the tip of the lower glume equals or exceeds this point or whether it definitely does not reach it. The nervation of the lower glume is important—it may be 1–3—nerved. Is the upper glume ciliate on the margins below? Examine the lemma—is the tip broadly rounded, obtuse—acute or even apiculate—is the keel strongly curved or straight in profile—are the nerves faint or conspicuous—is the dorsal surface, apart from the nerves and keel, scabrid, glabrous, hairy, 'granular or glandular-punctate'—are the nerves and keel glabrous or ciliate? Is the connecting wool at the base on the callus copious or sparse or is the callus quite glabrous? Measure the length of the stamens. Examine the keels of the palea. Are they smooth or scabrid above and ciliate below or are they ciliate all along or are they almost smooth with a very few hooked teeth above? It is advisable to soak the palea in water as the cilia sometimes do not become visible until they are teased out. Is the rhachilla smooth, glabrous, scabrid, pilose or verrucose?

The terms 'granular, gland-dotted, glandular-punctate' used above describe an impression given by the surface of some lemmas or on occasion, the palea, when viewed through a lens. The surface looks as if it were pitted, and the pits when viewed at a certain angle seem to glisten. These seemingly pit-like structures, are not glands but the silica cells, which by refraction of light at certain angles, give the illusion of pits. The *Pratensis* group of Poas shows this particularly well. It is advisable to use a power greater than ×10 to obtain the best effect.

Key to the species of *Poa*

Stems with a bulbous thickening at the base:—

- Lemmas entirely glabrous:—
  - Panicle contracted; 1·5 cm. long, 5 mm. broad; branches very short; spikelets congested; very slender grass, up to 15 cm. tall ... 46. *P. glabriflora*
  - Panicle spreading, 4–6 cm. long, 15–20 mm. broad; branches up to 3 cm. long, spreading; plants up to 40 cm. tall ... 47. *P. bactriana*
- Lemmas with some hairs at least on side nerves and keel:—
  - Lemmas 3·5–4 mm. long; spikelets rarely show proliferation; a grass of dry arid places ... 48. *P. sinaica*

Lemmas 2·5–3 mm. long; spikelets almost always exhibit proliferation; a mesophytic grass ... 49. *P. bulbosa*

Stems without any thickening at the base:—

Lemmas with a hairy covering on the dorsal surface between the nerves, often this reduced to a few hairs at the base of the lemma and dorsal surface of lemma coarsely scabrid, rarely shiny:—

Spikelets ovate in outline; base thick due to numerous short persistent leaf-sheaths; keels of the palea long ciliate below ... 42. *P. alpina*

Spikelets oblong, elliptic, lanceolate or wedge shaped:—

Inflorescence a spreading panicle:—

Lower glume equal to or longer than the lowest lemma in the spikelet:—

Lemmas hairy all over the dorsal surface; lowest lemma 2·5 mm. long; spikelets 4·5 mm. long ... 43. *P. hirtiglumis*

Lemmas hairy in lower half or less; lowest lemma 4 mm. long; spikelets 6·5 mm. long ... 33. *P. eleanorae*

Lower glume distinctly shorter than lowest lemma:—

Upper ligules short, under 1·5 mm. long:—

Tufted grasses; lower glume awl-shaped in profile:—

Keels of the palea ciliate in the lower half; margins of lemmas and glumes narrowly hyaline; basal sheaths disintegrating into brownish fibres; spikelets up to 5 mm. long; anthers 1 mm. long; wool copious ... 34. *P. burmanica*

Keels of the palea scabrid, margins of lemmas and glumes broadly hyaline; basal sheaths many, scarious, straw-coloured; spikelets up to 7 mm. long; anthers 2–2·5 mm. long; wool scanty ... 14. *P. polycolea*

Not tufted; lower glume lanceolate, not awl-shaped; anthers 2-3 mm. long, leaves and sheaths crowded at base of culm; glumes and lemmas finely granulate ... 35. *P. ludens*

Upper ligules longer, over 1·5 mm. long.

Lemmas very broadly hyaline ; spikelets pale ; basal sheaths scarious ; rhachilla joints not conspicuous ... 14. *P. polycolea*

Lemmas not very broadly hyaline, often purple; basal sheaths not scarious: rhachilla joints sometimes conspicuous from side :—

Lemmas more or less scabrid or dull all over the dorsal surface ; ligule 2–3·5 mm. long or more ; hairy covering of the lemma often reduced to a few hairs at the base :

Very slender grass, basal leaves setaceous ; rhachilla joints not conspicuous from the side ; upper glume 3–3·5 mm. long; lemma 4–4·5 mm. long ... 29. *P. pagophila*

Robust grass ; basal leaves flat ; rhachilla joints very conspicuous from side ; upper glume 4·5–5 mm. long ; lemma 4–5 mm. long 30. *P. falconeri*

Lemmas smooth, sometimes shining, on the dorsal surface, but often glandular punctulate ; ligule up to 5 mm. or more :—

Keels of the palea scabrid :—

Anthers over 2 mm. long ; wool present on callus :—

Glumes and lemmas broadly hyaline on the margins ; plants grey-glaucous ; lemmas 6 mm. long ... 31. *P. nitidespiculata*

Glumes and lemmas not broadly hyaline, plant green ; lemmas 4·5–5 mm. long ... 30. *P. falconeri*

Anthers under 2 mm. long :—

Wool absent ; lemmas 3·5–5·5 mm. long : paleas scabrid or semi-pilose on the keels :—

Leaves narrow, 2·5 mm. broad ; keels of palea scabrid ... 25. *P. asperifolia*

Leaves broad, 7 mm. broad ; keels of palea semi-pilose 32. *P. gammieana*

Wool present, very copious; lemmas about 2·5 mm. long; paleas ciliate on the keels 3. *P. nepalensis*

Keels of the pales ciliate below:—

Sheaths smooth; leaves narrow, 30 times as long as broad; panicle long exserted; ligule membranous, up to 5 mm. long; lemmatal nerves not particularly prominent; lower lemma at most 4 mm. long; a western species ... 8. *P. stapfiana*

Sheaths scabrid or asperulous; leaves broader, 10 times as long as broad acuminate; panicle not long exserted; ligule up to 4 mm. long; lemmatal nerves very prominent; lowest lemma 4·5–5 mm. long; an eastern Himalayan species ... 32. *P. gammieana*

Inflorescence contracted, dense, at most 6 cm. long, 1 cm. broad:—

Dwarf plants not above 15 cm. tall, very glaucous or not glaucous; keels of palea semi-pilose; wool present ... 44. *P. koelzii*

Much taller as a rule, not glaucous; palea shortly semi-pilose, cilia often reduced to a few hairs, scabrid above; wool absent or very sparse ... 20. *P. lahulensis*

Lemmas not hairy between the nerves but occasionally scabrid (*P. himalayana*):—

Anthers 2 mm. long or over:—

Ligules short not over 2 mm. long; lemmas prominently 5-nerved:—

Lemmas completely glabrous:—

Lemmas 5·5 mm. long, scabrid ... 36. *P. gamblei*

Lemmas not above 4 mm. long, smooth ... 15. *P. aitchisonii*

Lemmas ciliate on keels and side nerves, smooth; rhachilla joints conspicuously long; lower glume very narrow ... 14. *P. polycolea*

Ligules longer, 2·5–4·5 mm. long; lemmas inconspicuously 5-nerved:—

Panicle contracted; branches erect; lemmas smooth pale; margins of upper glume cilitae below ... 45. *P. tibetica*

Panicle lax; branches spreading; margins of upper glume eciliate:—

Lemmas scabrid, broadly hyaline; glumes and lemmas very dull, green or purplish. 29. *P. pagophila*

Lemmas smooth, hyaline on margins; glumes and lemmas shining, pale or yellowish; lemmas often with a yellow streak below hyaline portion ... 17. *P. sterilis*

Anthers under 2 mm. long :—

Wool present on the callus :—

Ligules short not more than 1 mm. long; keels of palea scabrid :—

Lower glume lanceolate, 1-nerved, 2–2·5 mm. long; lemmas almost glabrous, hyaline at the tip only, distinctly 5-nerved ... 11. *P. khasiana*

Lower glume awl-shaped, 3-nerved, 2·5–3 mm. long; lemmas ciliate on the keel and side nerves; hyaline in upper quarter, faintly 5-nerved ... 13. *P. nemoralis*

Ligules over 1 mm. long; or if less keels of palea semi-pilose or ciliate :—

Keels of palea ciliate below, scabrid above ... 10. *P. stewartiana*

Keels of palea either scabrid or ciliate throughout :—

Keels of palea ciliate throughout :—

Panicle branches whorled in 4's; keel and lateral nerves of lemma ciliate; wool scanty; leaves up to 5 mm. broad; panicle green ... 4. *P. nephelophila*

Panicle branches in pairs; keel and lateral nerves of lemmas densely ciliate; wool copious; leaves up to 4 mm. broad; panicle silvery ... 3. *P. nepalensis*

Keels of palea scabrid throughout :—

Stems and sheaths compressed; side nerves of lemma obscure; spikelets rather crowded in the panicle... 28. *P. compressa*

Stems and sheaths terete :—

Lower sheaths scabrid :—

Ligule long, pointed, more than 1·5 mm. long; panicle in distinct whorls of 4–6 (usually 5); side nerves of lemma prominent; inflorescence spreading; base not curved ... 22. *P. trivialis*

Ligule short, just over 1 mm. long; panicle branches in 2's or alternate: lemmatal nerves obscure; panicle compact; base curved ... 23. *P. alpigena*

Lower sheaths smooth :—

Lemmas very broad, rounded on back and hyaline at the tips :—

Lemmas strongly compressed, up to 3·75 mm. long; palea scabrid with many teeth ; a dwarf plant not more than 4 cm. tall ; panicle glabose compact ; spikelets dark purple ... ... 39. *P. phariana*

Lemmas rounded on the back ; palea with distant teeth on the keels ; up to 10 cm. tall, with long reflexed panicle-branches ; spikelets suffused gold and purple or green ... 41. *P. calliopsis*

Lemmas not broad ; acute or narrowly obtuse at the tip :—

Lowest branches of the panicle 3–5-nate ; grasses with shortly or extensively creeping rhizomes or short or long stolons :—

Perennials, loosely or densely tufted, with short stolons ; ligules acute or obtuse ; side nerves of the lemmas obscure or prominent :—

Ligules pointed, 3–4 mm. long ; side nerves of the lemmas very prominent ; lemmas green :—

Stems and basal sheaths scabrid ... 22. *P. trivialis*

Stems and basal sheaths smooth ... 22. *P. trivialis* f. *glabra*

Ligules rounded 3 mm. long ; side nerves of the lemmas very obscure ; lemmas with a brown or copper streak below the hyaline tip ... 21. *P. palustris*

Perennials with widely creeping rhizomes forming scattered vegetative shoots or culms or tufts of these; ligules truncate; side nerves of the lemmas very conspicuous:—

Plants erect from the base:—

Basal leaves narrow, almost setaceous; lemmas 2·5–3 mm. long ... 24. *P. angustifolia*

Basal leaves broad, flat; lemmas 3–4·5 mm. long:—

Ligules not more than 2 mm. long; lemmas 3–3·5 mm. long ... 27. *P. pratensis*

Ligules 2·5–6 mm. long; lemmas 3·5–4·5 mm. long ... 26. *P. jaunsarensis*

Plants conspicuously curved at the base ... 23. *P. alpigena*

Lowest branches of the panicle 2-nate, occasionally 3-nate; plants non-rhizomatous or with a thick horizontal or inclined rootstock (*P. araratica*):—

Lower glume equal to or longer than the lowest lemma:—

Panicle spreading; glumes acute not acuminate or subulate:—

Lemmas 2·25–2·5 mm. long ... 40. *P. rhadina*

Lemmas 5–6 mm. long 33. *P. eleanorae*

Panicle very narrow, linear-oblong with ascending branches: glumes subulate in profile ... 16. *P. setulosa*

Lower glume definitely shorter than the lowest lemma:—

Panicle narrow:—

Plants very glaucous ... 19. *P. litwinowiana*

- Plants not at all glaucous:—
  - Branches not more than 2 cm. long; spikelets elliptic or lanceolate usually suffused with violet, base of plant reddish mauve; rhizomatous, rootstock stout ... 18. *P. araratica*
  - Branches over 3 cm. long; spikelets wedge-shaped, green or yellowish green; lemmas broadly hyaline on the margins; plants green or pale at the base; no stout rootstock ... 17. *P. sterilis*

- Panicle spreading:—
  - Lemmas quite glabrous; broadly hyaline on the margins ... 15. *P. aitchisonii*
  - Lemmas at least ciliate on the keel and nerves; narrowly or broadly hyaline on margins and at the tip.
    - Lower glume reaching half-way up the lowest lemma or less; lemmas 4–4·5 mm. long; lowest branches of panicle 2-nate ... 9. *P. himalayana*
    - Lower glume longer than half the lowest lemma; lemmas 3–4 mm. long:—
      - Lemmatal nerves conspicuous; lower glume very narrow, 1-nerved; spikelets green; lowest branches of the panicle 3–5-nate ... 11. *P. khasiana*

Lemmatal nerves faint; lower glume lanceolate or elliptic, 3-nerved; spikelets yellowish green; lowest branches of the panicle 2-nate ... 17. *P. sterilis*

No wool on the callus:—

Ligules less than 1 mm. long ... 11. *P. khasiana*

Ligules over 1 mm. long:—

Keels of the palea ciliate below, scabrid above ... 7. *P. sikkimensis*

Keels of the palea either ciliate or scabrid throughout:—

Keels ciliate:—

Intermediate nerves of lemma glabrous; anther 1·2–1·6 mm. long ... 5. *P. supina*

All nerves of the lemma hairy; anthers less than 1 mm. long:—

Anthers 0·2–0·3 mm. long; upper floret markedly dissimilar to the lower ... 2. *P. infirma*

Anthers 0·6–0·8 mm. long; upper floret similar to the others ... 6. *P. annua*

Keels of palea scabrid:—

Culms scabrid below the panicle:—

Lemmatal nerves conspicuous; lemmas scabrid; anthers less than 1 mm. long ... 12. *P. wardiana*

Lemmatal nerves obscure; lemmas smooth; anthers over 1·5 mm. long:—

Spikelets wedge-shaped, 5–6 mm. long, 4–several-flowered; panicle widely spreading; lemma broadly hyaline at the tip, narrowly so on the margins, obtuse, sparsely pubescent on the nerves; a yellowish band present below the hyaline tip; panicle ± lax; culms 30–60 cm. tall; plant green ... 17. *P. sterilis*

Spikelets elliptic or lanceolate, 2–3(4)-flowered, 4–5 mm. long; panicle of closely crowded spikelets; lemmas not broadly hyaline, usually acute, markedly pubescent on the nerves; no yellowish band below the tip; plants very glaucous, up to 30 cm. tall ... 19. *P. litwinowiana*

Culms smooth below the panicle:—

Culms strongly compressed ... 28. *P. compressa*

Culms terete :—

Glumes usually equal to or longer than lowest lemma; if shorter, then base covered with long scarious sheaths; panicle strict, shortly exserted ... 37. *P. amoena*

Glumes definitely shorter than lowest lemma; basal sheaths not long scarious; panicle usually long exserted :—

Lemmas quite glabrous on dorsal surface; inflorescence a narrow linear panicle ... 38. *P. poophagorum*

Lemmas with at least keel and side nerves ciliate :—

Inflorescence a spreading panicle :—

Spikelets up to 6 mm. long; lemmas 3·5–3·75 mm. long; anthers 2–2·5 mm. long ... 15. *P. aitchisonii*

Spikelets up to 3·25 mm. long; lemmas 2–2·5 mm. long; anthers 0·4–0·5 mm. long ... 1. *P. tibeticola*

Inflorescence a strict panicle ... 38. *P. poophagorum*

I. Ochlopoa

1. **Poa tibeticola** Bor, in Kew Bull. **1948** : 139, 1948.

An annual or perennial (?) grass with very leafy, slender stems. *Culms* from a few centimetres up to 25 cm. tall, 0·3 mm. in diameter just below the panicle, very smooth and glabrous, erect or shortly geniculate at the base, covered below with the remains of earlier leaf sheaths; nodes smooth and glabrous, becoming visible as the sheaths slip from the culm. *Leaf-blades* soft and flaccid, up to 25 cm. long by 2 mm. broad, linear-acuminate in shape, tapering gradually to a very firm, scabrid, stout tip, contracted abruptly at the base to the sheath, cartilaginous on the margins, smooth in the central portion and armed with antrorse teeth at the tip and retrorse teeth at the base, very minutely scabrid on the nerves on both surfaces, distinctly veined *Sheaths* rather loose, the lowest slipping from the culm and disintegrating into fibres, the central somewhat inflated while the uppermost clasps the stem firmly, very striate, scabrid on the nerves with downwardly directed teeth. *Ligule* membranous, erose at the tip, scabrid on the outside, 2–3 mm. long.

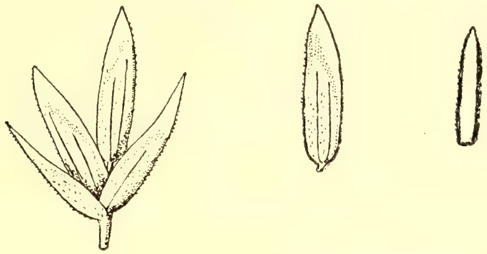


Fig. 1. *Poa tibeticola* Bor, × 10

Inflorescence an oblong panicle up to 10 cm. long by 5 cm. broad, very delicate ; axis smooth and glabrous or very minutely scabrid below ; branches about 1 cm. long, capillary, very flexuous, coarsely scabrid, for the most part binate at the nodes, sometimes 3-nate ; branchlets short, coarsely scabrid, sparsely branched, carrying a small number of spikelets. *Spikelets* 2–3-flowered, seated on short scabrid pedicels, up to 3·25 mm. long, elliptic-oblong in shape ; florets diverging at anthesis. *Lower glume* 1·5–3 mm. long, 0·8 mm. in width, lanceolate- or oblong-acuminate in shape when flattened, narrowly hyaline along the margins, curved or almost straight on the keel in profile, 1–3-nerved, scabrid on the keel, covered on the dorsal surface with asperities in the upper third or upper two-thirds. *Upper glume* 2–2·25 mm. long, 1 mm. wide, elliptic- or ovate- or lanceolate-acuminate or -acute when flattened, slightly curved on the back, 3-nerved, hyaline on the margins up to the lateral nerves, scabrid on the keel, covered with asperities on the dorsal surface in the upper two-thirds. *Lowest lemma* 2 mm. long or little longer, oblong-obtuse or broadly elliptic-obtuse in shape, often erose at the hyaline tip, hyaline along the margins, distinctly 5-nerved, scabrid on the keel to the base and along the lateral and intermediate nerves, covered on the dorsal surface with asperities, or free from asperities and minutely glandular-punctate in the lower half, no trace of cilia on the keel and lateral nerves. *Rhachilla* minutely scabrid, produced beyond the topmost floret and covered with a rudimentary floret. *Anthers* minute 0·4–0·5 mm. long. *Wool* absent. *Palea* shorter than the lemma, scabrid on the keels.

Tibet: Khambajong, 7 Sept. 1903, *Younghusband* 304; Lhasa, Sept. 1904 *Walton*.

Sikkim: Chugyu, 5,000 m., 12 Sept. 1912, *Rohmoo Lepcha* 284.

A very delicate species with minute spikelets which are perfectly glabrous without a trace of cilia or wool. The keels of the palea are scabrid. The specimen from Chugyu is not more than 3 cm. tall.

2. **Poa infirma** H.B.K., Nov. Gen. et Sp. **1** : 158 (1815) 27.

P. exilis (Tomm.) Murb. in Ascher. et Graebn., Syn. Mitteleurop. Flora **2**: 389 (1900).

P. remotiflora Murb., Contrib. Flor. nor.-ous. Afr. **4**: 22 (1900).

P. annua Linn., ssp. *exilis* Tomm. apud Freyn. Zool.-Bot. Ges. **27**: 469 (1877).

Catabrosa thomsoni Stapf ex Hook. f., Flor. Brit. Ind. **7**: 311 (1896).

A strictly annual grass. *Culms* rather slender and weak, smooth and glabrous, up to 10 cm. tall, occasionally twice as tall, sheathed almost to the inflorescence. *Leaf-blades* soft, flaccid, linear, abruptly contracted to a blunt point, up to 6 cm. long, 5 mm. broad, scabrid on the margins and on the midrib below, very scabrid at the tip, very thin. *Sheaths* rather loose, herbaceous, smooth and glabrous, somewhat inflated at the base of the plant. *Ligule* membranous, entire, 1–2 mm. long, rounded or obtuse at the tip.

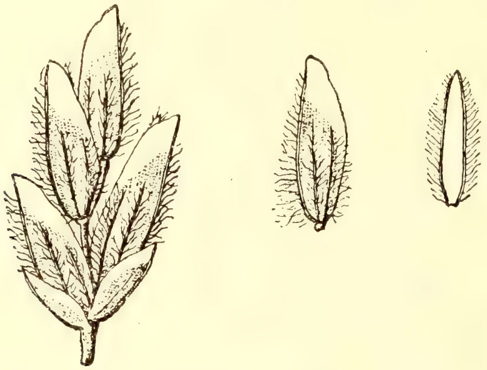


Fig. 2. *Poa infirma* H.B.K., × 10

Inflorescence a narrow, oblong, rather open panicle with branches ascending, rarely horizontal, and never deflexed; axis smooth and glabrous, angled; branches smooth and glabrous, in pairs, often a longer accompanied by a shorter, up to 2 cm. long, carrying rather remote spikelets at anthesis. *Spikelets* 4–4·5 mm. long, 3–5-flowered, oblong-obtuse in shape, with remote florets which occasionally hide the joints of the rhachilla, seated, except the terminal, on very short pedicels. *Lower glume* 1·25 mm. long, 0·6 mm. wide, oblong-acute in shape, slightly curved on the back, broadly hyaline on the margins, smooth and glabrous. *Upper glume* 1·5 mm. long, 1 mm. wide, broadly elliptic-obtuse in shape when flattened, very broadly hyaline on the margins and at the tip, 3-nerved, smooth and glabrous. *Lemma* 2·5 mm. long, 1·5 mm. wide, widest above the middle, oblong-ovate-obtuse or almost round at the tip, herbaceous in texture, faintly 5-nerved, very broadly hyaline at the tip and along the margins, almost straight on the back, thickly ciliate on all nerves or occasionally thinly ciliate. Wool absent. *Rhachilla* produced and carrying a rudimentary spikelet, smooth and glabrous. *Anthers* minute, 0·22–0·33 mm. long. *Palea* shorter than the lemma, long ciliate on the keels.

Ind. Or.: Rawalpindi, 21 April 1930, *R. R. Stewart* 10755; Dehra Dun, Robber's Cave, 780 m., 29 Feb. 1928, *Umras Singh* 317.

Tibet: Bilaspur, *Duthie* s.n.; Nubra Valley, 3–3,500 m., *T. Thomson.*

This delicate little species is comparatively rare, having been collected on four occasions only. It is a strictly annual species and bears only a superficial resemblance to *P. annua.* The chromosome number : 2n = 14. The panicle is oblong in shape, and the branches either ascending or approximately horizontal with spikelets loosely scattered along them. All lemmatal nerves are hairy, but there is no wool at the base of the lemma. The anthers are tiny, being only 0·2–0·3 mm. long. As in *P. annua* Linn. the apical floret is female while all those below it are hermaphrodite. One of the remarkable features of the plant is the thinness of the leaves which are almost translucent.

The identity of *Catabrosa thomsoni* Hook. f. with this plant was quite unexpected and only came to light when the Indian species of *Colpodium* were being studied. The type sheet is at Kew and although the material is meagre and well glued down on the sheet, there is no doubt that the plant represented is *Poa infirma* H.B.K.

Tutin (1952) succeeded in crossing *P. annua* and *P. infirma*, pollen from the latter being used. The hybrid is completely sterile and has 2n = 21, as was to be expected.

Tutin points out that at meiosis seven univalents and seven bivalents are present, and concludes that this condition could only occur if *P. infirma* were one of the parents of *P. annua.* So far no one has demonstrated by an actual cross that *P. infirma* and *P. supina* are the parents of *P. annua.*

3. **Poa nepalensis** Wallich *ex* Duthie, Grasses of North-western India, 40 (1883).

P. annua Linn., var. *nepalensis* Griseb. in Goett. Nachr., 75 (1868).

A tall perennial grass from a creeping rootstock which gives off numerous rootlets from the nodes. *Culms* up to 50 cm. tall, erect, smooth and glabrous, terete, long exserted from the uppermost leaf-sheath, 2–3-noded, geniculate at the base. *Leaf-blades* up to 15 cm. long, 4 mm. wide, linear, tapering to a sharp point, flat, flaccid, shorter or longer than the supporting sheath, scabrid on both surfaces and along the margins. *Sheaths* rather loose, smooth and glabrous, eventually slipping from the culm. *Ligule* membranous, not more than 1·5 mm. long.

Inflorescence a large, pyramidal panicle up to 14 cm. long by 10 cm. wide; central rhachis smooth and glabrous; branches in pairs (one of a pair much shorter than the other), smooth and glabrous, almost capillary, bare at the base for one-third to one-half their total length, shortly rebranched into 2 or 3 arms which occasionally are shortly branched. *Spikelets* whitish in colour, about 4-flowered, 3·5–4 mm. long, elliptic-acute when young, with spreading florets at anthesis. *Lower glume* 1·5–2 mm. long. 0·6 mm. wide, pale in colour, curved on the back, 1-nerved, hyaline on the margins, smooth and glabrous, apart from the rough upper part of the keel. *Upper glume* 2·25–2·5 mm. long, 1·4 mm. wide, broadly elliptic-acute or elliptic-ovate-acute in shape when flattened, 3-nerved, curved on the back, pale glaucous in colour, hyaline on the margins, scabrid on the upper half of the keel. *Lemma* 2·5 mm. long, 2 mm. wide, oblong-elliptic-obtuse in shape, very narrowly hyaline on the margins and at the tip, 5-nerved with inconspicuous intermediate nerves, profusely ciliate on the lateral nerves and on the lower two-thirds of the keel, glabrous in between, very faintly punctate all over the dorsal surface, minutely scaberulous in the lower third. Rhachilla smooth and glabrous. *Wool* copious. *Anthers* linear 0·75 mm. *Palea* shorter than the lemma, broadly oblong-elliptic, long ciliate on the keel to within one-eighth of the apex.

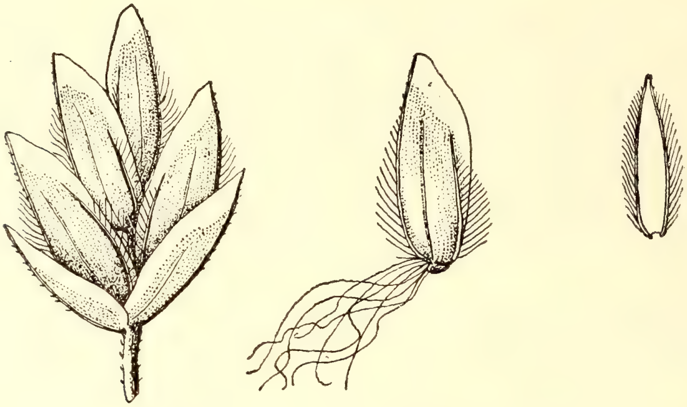
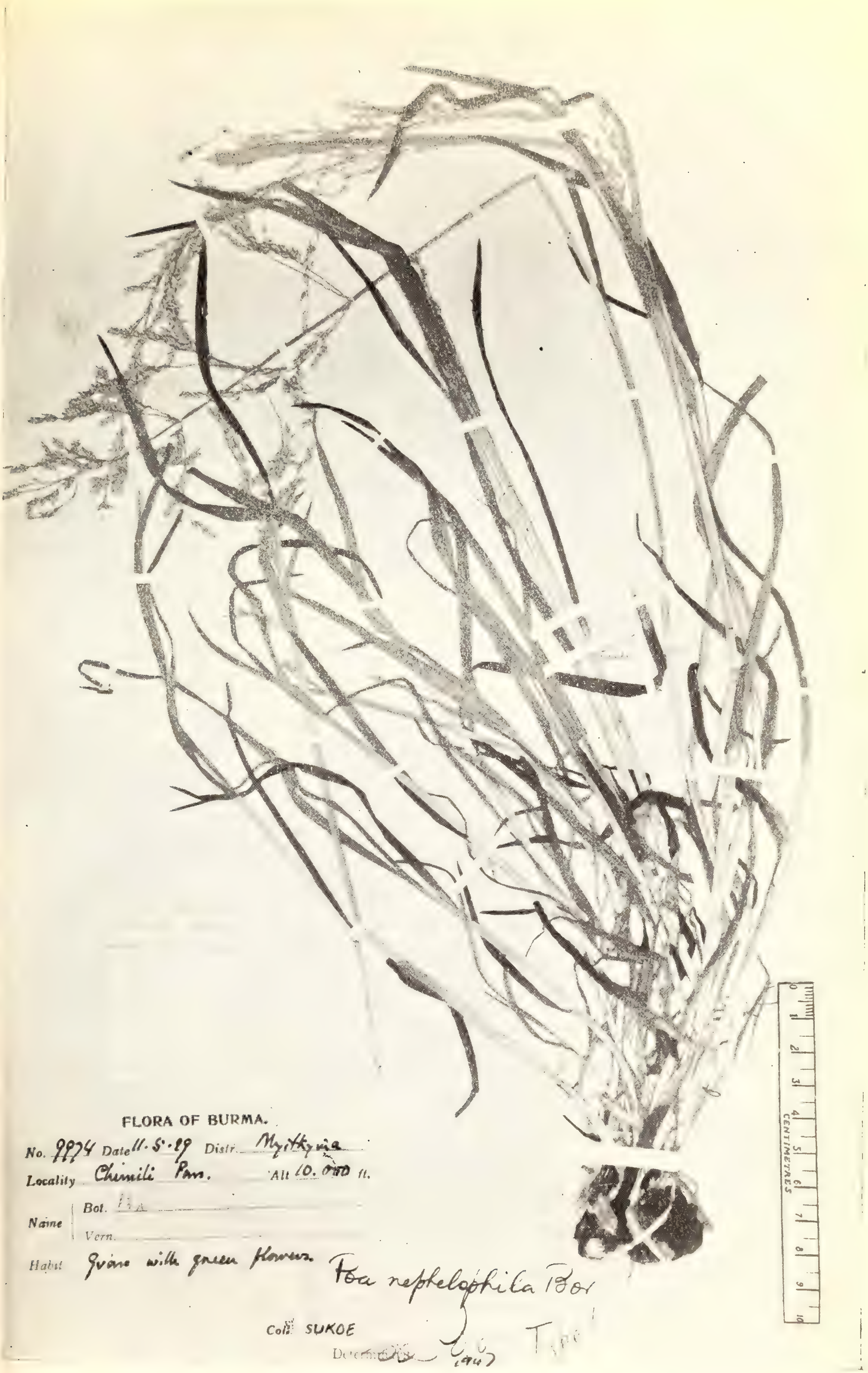


Fig. 3. *Poa nepalensis* Wall., × 10

Ind. Or.: Kumaon, Binsar, 2,300 m., *Strachey et Winterbottom* (Type); Tehri Garhwal, Thadiar, 1,000 m., May 1893, *Gamble* 24194; Kulu, Manali, 2,700 m., 9 May 1941, *N. L. Bor* 14101; Dalhousie, 29 Sept. 1874, *C. B. Clarke* 23275c.

The name *Poa nepalensis* Wall. first appears in Duthie's Grasses of North-western India, 40 (1883) where the specimens cited are those of T. Thomson from N.W. India and Strachey and Winterbottom's sheet; from Binsar in Kumaon. In the Flora of British India, Hooker returns to the name *Poa annua* L. var. *nepalensis* which had been given to it by Grisebach in Goett Nachr., N. 3, 75 (1868) who based the variety on two sheets, viz. Strachey's from Kumaon and Hooker's from the Eastern Himalaya. In point of fact all these sheets represent the same species and Strachey and Winterbottom's is selected as the type.

In the Flora of British India, Stapf who worked out this genus introduced another complication, for this species is again reduced to the status of a variety of *Poa annua* but the specimens upon which it is based were altered to *P. annua* β Nees in Herb. Royle and *Poa* Wall. Cat. No. 3791. Royle's specimen is *P. nepalensis* but Wallich's No. 3791 does not fit the description given by Stapf and actually is a different species.



FLORA OF BURMA.

No. 9974 Date 11·5·29 Distr. Myitkyina

Locality Chimili Pass. Alt 10.000 ft.

Name Bot.

Vern.

Habit Grass with green flowers.

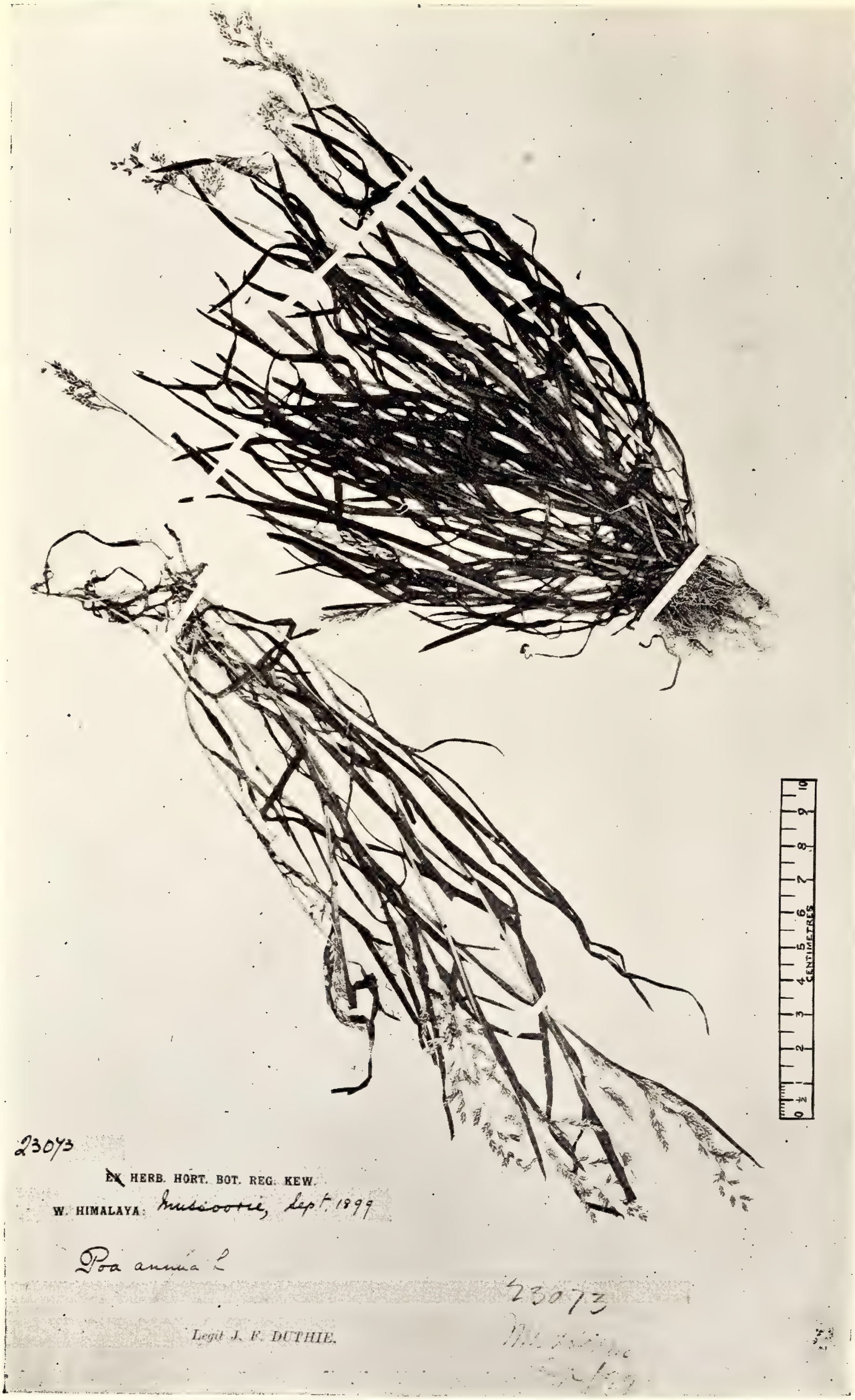
Poa nephelophila Bor

Type!

Colr. SUKOE

Determd. 1947

Poa nephelophila Bor



Poa annua Linn.

According to Stapf the characteristics of *P. annua* var. *nepalensis* were, among others, that the keel and outer nerves of the lemma were silky and the wool copious. In Wallich's No. 3791 the lemma is almost glabrous and the wool non-existent. In fact Wallich's 3791 does not conform to the description and, moreover, it is not identical with Strachey and Winterbottom's specimen, nor is it the other specimen to which Duthie refers, namely T. Thomson's specimen. It is therefore quite clear that Wallich No. 3791 must be excluded from consideration. It really is quite a different species, namely, *P. sikkimensis* Bor.

4. **Poa nephelophila** Bor, in Kew Bull. **1948:** 139 (1948).

A very leafy, stout, lax, annual grass. *Culms* up to 45 cm. tall, by 1·5 mm. in diameter just below the panicle, to 3 mm. at the base, very smooth and glabrous, erect or slightly geniculate below, clothed at the base with disintegrating old sheaths; nodes smooth and glabrous, visible because of the loose sheaths. *Leaf-blades* green, lax and flaccid, flat, 16 cm. long by 5 mm. broad, linear in shape, tapering gradually to a sharp point, narrowly cartilaginous on the margins which are armed with widely spaced, forwardly pointing teeth, scabrid at the tip on margins and surfaces, very minutely scabrid on the upper surface, often with a few hairs on the margin at the rounded base. *Sheaths* very lax and loose, slipping from the culm and exposing the nodes, smooth and glabrous, minutely striate, the lower falling away completely and surrounding the base of the culm, the upper more or less clasping the stem, shorter than their leaves. *Ligules* short, membranous, erose, not more than 1·5 mm. long.

Panicle pyramidal, up to 12 cm. long, 9 cm. broad; axis stout to capillary, smooth and glabrous, nodes up to 3·5 cm. apart; branches whorled in 4's, smooth and glabrous, up to 3·5 cm. long before branching; branchlets scaberulous, sparsely rebranching and carrying a few crowded spikelets. *Spikelets* narrowly oblong in shape, 5–6·5 mm. long, 4–6-flowered, pale green. *Lower glume* 2- 2·5 mm. long, 0·8 mm. broad, 1-nerved, oblong- or lanceolate-acuminate when flattened, curved on the keel, narrowly hyaline along the margins in a definite band; smooth and glabrous except the keel which is most minutely scabrid along the whole length. *Upper glume* 2·5–3 mm. long, 1·5 mm. broad, curved on the back, elliptic-acuminate in shape when flattened, hyaline in a definite narrow band on the margins, 3-nerved, smooth and glabrous except for the keel which is minutely scabrid. *Lowest lemma* 3·5 mm. long, 2 mm. wide when flat, oblong-obtuse in shape when flattened, distinctly 5-nerved, very shortly hyaline at the tip and along the margins, ciliate on the keel in the lower two-thirds, scabrid on the keel above, ciliate on the lateral nerves, not ciliate on the intermediate nerves. *Wool* practically absent. *Rhachilla* long jointed; joints 0·75 to 1 mm. long, glabrous. *Anthers* minute, 0·6–0·75 mm. long. *Palea* shorter than the lemma, ciliate on the keels.

Burma: Chimli Pass, 3,300 m., 11 May 1929, *Sukoe* 9974 (Type).

A very leafy species with a large panicle the branches of which are 4-nate.

Very close to *P. annua* Linn., but it has a very different appearance—the spikelets are slightly larger, the panicle branches are in whorls of four and the intermediate nerves of the lemma are glabrous.

5. **Poa supina** Schrad., Flor. Germ. **1**: 289 (1806).

A perennial grass, sending out leafy runners above ground. *Culms* up to 25 cm. tall, usually not much more than 15 cm., usually decumbent at the base, clothed with leaves almost to the tip and with old sheaths in the lower part. *Leaf-blades* linear and contracted suddenly to a rather stout tip, 1–2·5 cm. long, 2–3 mm. wide, dark green, flaccid, more usually flat, sometimes folded, scabrid along the margins, especially towards the rather short tip; those of the sterile shoots much longer up to 6 or 7 cm., and correspondingly broad. *Sheaths* at the base much longer than the internodes, very loose, scarious, smooth and glabrous, shining, hyaline on the margins, those of the culm much tighter, clasping, striate, smooth and glabrous, hyaline on the external margin. *Ligule* membranous up to 1·5 mm. long, rounded at the tip.

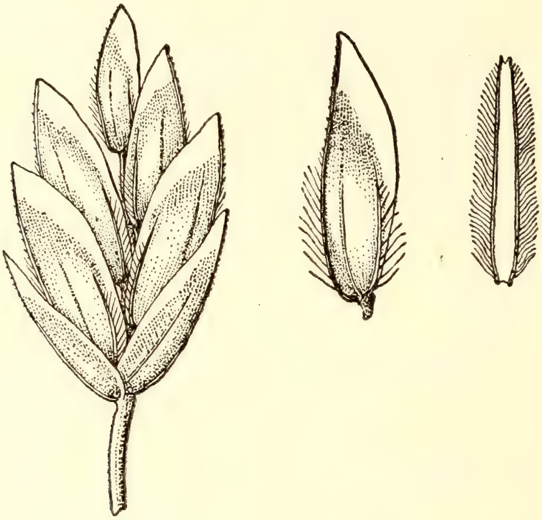


Fig. 4. *Poa supina* Schrad., × 10

Inflorescence, at first a dense, pyramidal, usually purplish panicle, usually as long as broad, afterwards spreading and finally with deflexed branches; axis smooth and glabrous; branches in pairs or often single, the single branch soon dividing into two equal branchlets which rebranch, smooth and glabrous. *Spikelets* 5–6-flowered, 4–5 mm. long, clustered at the ends of thin branchlets. *Lower glume* 1·5 mm. long. 0·8 mm. wide, oblong-acute in shape when flattened, slightly curved on the back, 1-nerved, hyaline at the tip and narrowly along the margins, smooth and glabrous, suffused with purple. *Upper glume* 2·5 mm. long, 1·2–1·3 mm. wide, elliptic-acute or elliptic-obovate-acute in shape, suffused with purple, 3-nerved, narrowly to broadly hyaline on the margin, hardly hyaline at the tip, minutely scabrid on the keel. *Lemma* 2·5–3–3·5 mm. long, 2–3 mm. wide, herbaceous, broadly elliptic-obtuse or oblong-ovate-obtuse in shape when flattened, 5-nerved, very hyaline at the tip and hardly hyaline along the margins, prominently 5-nerved, ciliate on the keel in the lower half or two-thirds, scabrid on the keel above, ciliate on the marginal nerve, otherwise smooth and glabrous.

Rhachilla smooth and glabrous, produced beyond the topmost floret and carrying a rudimentary floret. *Wool* absent. *Anthers* 1·2–2 mm. long. Upper floret several times longer than the rhachilla joint. *Palea* shorter than the lemma, ciliate on the keels.

Ind. Or.: Himalaya; Tehri Garhwal, 4,000 m., 28 Sept. 1948, *W. Koelz,* 22025; Kashmir, Baltal in Sind Valley, 3-3,700 m., 28 June 1892, *Duthie* 11599 Hazara, Suan Valley, 29 June 1896, *Mayat* 20352; Gulmarg, 2,700-3,000 m., 26 June 1893, *Duthie* 13032; Lahul, above Kandang, 6 July. 1888, *Drummond* 23354. Chitral; Barum Gol, Shokor Shal, 3,300 m., 22 June 1950, *Per Wendelbo* s. n., ' by a brooklet'.

This very distinctive grass is found in the Himalaya at altitudes above 2,000 m. only. The panicle is broadly triangular in shape, and the branches, either horizontal or deflexed, with the spikelets crowded at the tips of the branches, give a facies which is quite different from that of *P. annua.* The intermediate lateral nerves of the lemma are glabrous. There is no wool at the base of the lemma. The anthers are larger (often 3 times as large) than those in *P. annua,* being 1·6–2 (2·5) mm. long. The keels of the palea are long ciliate. This is always a perennial grass. The chromosome number of *P. supina* Schrad. is 2n = 14 (Nannfeldt 1935). The apical floret in the spikelet is female, while all the others are hermaphrodite.

6. **Poa annua** Linn., Sp. Pl. ed. 1, 68 (1753).

P. royleana Steud., Syn. Pl. Glum. 256 (1854).

An annual, sometimes biennial or exceptionally a perennial, grass. *Culms* erect or more often geniculate, ascending from a fibrous rootstock, up to 30 cm. tall, usually much shorter. Runners often rooting at the nodes, forming buds in the axils of the sheaths which immediately develop, and after bursting through the sheaths send out other runners and vertical stems which flower. *Leaf-blades* usually 2-3·5 cm. long, but often very much longer in favourable habitats up to 5 mm. wide, linear, suddenly contracted to a stout tip, flat, flaccid, dark green, scaberulous on the margins. *Sheaths* somewhat compressed, smooth and glabrous, covering the nodes or not. *Ligule* of the upper leaves up to 3 mm. long, of the lower much less, often only 1·5 mm. long.

Inflorescence a loose pyramidal panicle, often one-sided, 1·2–1·6 times as long as broad; branches 2-(rarely 3–5-)nate or solitary, spreading, eventually almost deflexed, 2–8 mm. long before branching, smooth and glabrous. *Spikelets* more or less crowded, seated on scabrid pedicels, 3–5-flowered, ovate or elliptic-oblong in shape, 4–6 mm. long, green, sometimes tinged with violet. *Lower glume* 1·5–2 mm. long, 1 mm. wide, lanceolate-acute or -acuminate in shape, 1–nerved, hyaline on the margins, scabrid on the keel. *Upper glume* 2–2·5 mm. long, 1·5 mm. wide, elliptic-acute when flattened, 3–nerved, with a conspicuous hyaline or whitish band all along the margin, scabrid on the keel. *Lemma* 3 mm. long, 1·5 mm. wide, oblong-obtuse, herbaceous in texture with a broad hyaline or whitish band all along the margins, 5 -nerved, silky ciliate on the keel for three-quarters of its length, cilliate on the lateral nerves below, for the rest smooth and glabrous. Lowest floret hermaphrodite, the upper 1 or 2 female, the topmost seated on a rhachilla section, about one-half as long as the floret. *Wool* absent. *Rhachilla* smooth and glabrous, produced beyond the topmost floret and crowned with a rudimentary floret. *Anthers* 0·6–0·8 mm. long, yellow. *Palea* elliptic-truncate, long ciliate on the keels, but occasionally almost glabrous though usually some hairs will be discovered.

This cosmopolitan grass is found everywhere in India and Burma above the 1,300 m. contour. Sir Joseph Hooker collected it on Wallanchoon Pass in Sikkim at 4,000 m. altitude, and it is probably found at even greater heights in shaded places. A specimen has recently been collected in Delhi. This was sent to Kew by Shri M. B. Raizada, Forest Botanist, Forest Research Institute, Dehra Dun, with the observation that it is to be found in Delhi in cool shady places in winter. Actually there is no reason why *Poa annua* should not flourish in the cold season in Delhi where the temperatures, at least at night, in the winter are very low. The extensive irrigation system in the plains would facilitate the transport of seed from the hills.

This species is usually found as an annual, though it is sometimes a biennial, rarely perennial. In England the flowering period is often prolonged and sometimes starts as early as December. The hairiness of the lemmatal nerves is variable but all of them are more or less hairy. The anthers are medium sized, 0·6–0·8 mm. long. Wool at the base of the lemma is absent. The keels of the palea are covered from the base up to the tip with long cilia, but in some races the hairs are much reduced in number or almost entirely absent.

The chromosome number is $2n=28$ and frequent hybrids between it and *Poa supina* Schrad. have been obtained in Sweden (Nannfeldt 1935), suggesting that it hybridises freely in nature. The chromosome number of the hybrid is $2n=21$. According to Hackel the apical floret is ordinarily earlier in opening than the lower florets. This is contrary to the normal sequence of flowering in grasses. Moreover, this floret is female in sex but all those below it are hermaphrodite. This is a characteristic of the closely allied species *P. supina* Schrad. and *P. infirma* H.B.K.

Nannfeldt (1937) has speculated concerning the origin of *Poa annua* Linn. He points out that on morphological grounds alone the probability that *Poa annua* Linn. is an allotetraploid and is the result of a cross between *P. supina* Schrad. and *P. infirma* H.B.K. is very strong, since the morphological characters of *P. annua* are intermediate in every particular between those of the other two. Moreover it shows all the characteristics of hybrids, not only in hybrid vigour, but in its great adaptability to varying ecological conditions. At the present time it is one of the most cosmopolitan of grasses, and shows all intermediates between strictly annual plants and subperennials. Further evidence that Nannfeldt's hypothesis may be correct is deduced by Tutin (1952) who succeeded in pollinating *P. annua* with pollen from *P. infirma*. The hybrid is sterile and has $2n=21$. At meiosis it has seven bivalents and 7 univalents, a condition which could only arise if *P. infirma* were in effect a parent of *P. annua*.

7. **Poa sikkimensis** Bor, in Kew Bull. **1952**: 130 (1952).

P. annua Linn. var. *sikkimensis* Stapf in Hook. f., Flor. Brit. Ind. **7**: 346 (1896).

An annual or subperennial grass. *Culms* up to 30 cm. tall, usually geniculate at the base, with many fibrous roots, covered at the base with the scarious remains of old sheaths, smooth and glabrous, covered with leaves almost to the panicle, terete. *Leaf-blades* flat, linear, tapering to a blunt point, suddenly contracted at the base to the sheath, smooth and glabrous on both surfaces, or minutely to strongly scabrid at the tip, margins usually scabrid, sometimes smooth, up to 10 cm. long, 5 mm. wide, flaccid, green. *Sheaths* rather loose below, tight above. *Ligule* long, membranous, smooth, 3–6 mm. long, erose at the top.

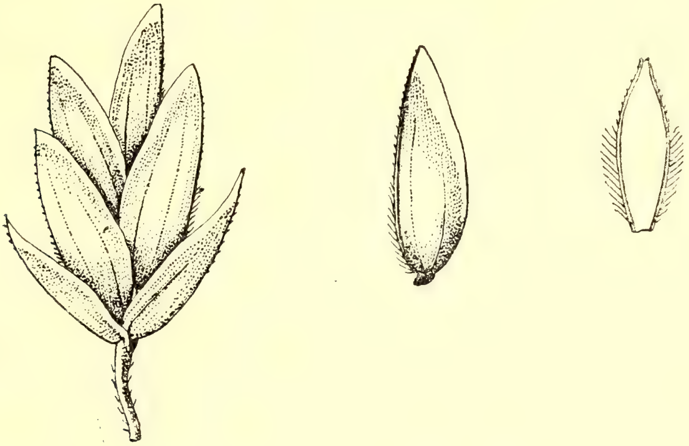


Fig. 5. *Poa sikkimensis* Bor, × 10

Inflorescence a panicle up to 15 cm. long, pyramidal or oblong in shape; axis smooth and glabrous; nodes often wide apart, the length of the lowest internode may be 4 cm.; branches binate, flexuous, capillary, ascending divergent or even deflexed; branchlets nearly always scaberulous. *Spikelets* oblong in shape, up to 4 mm. long, 3–4-flowered; pedicels short, scabrid. *Lower glume* 1·5–2 mm. long, 0·8 mm. wide, mostly 3-nerved, rarely 1- or 2-nerved, sometimes indistinctly, hardly hyaline on the margins, lanceolate- or oblong- or narrowly elliptic-acute when flat, suffused with purple. *Upper glume* 2·5–2·75 mm. long, 1·5 mm. wide, broadly elliptic-obovate-acute when flattened, 3-nerved, denticulate on the margins, scabrid on the upper half of the keel, hardly hyaline on the margins, smooth and glabrous. *Lemma* 2·75–3 mm. long, 2 mm. wide, broadly elliptic-obovate-obtuse when flat, somewhat firmly chartaceous, narrowly hyaline all along the margins to the top, rather faintly 5-nerved, shortly ciliate on the keel in the lower half, scabrid on the keel above, glabrous on the intermediate nerves, glabrous or ciliate on the lateral, smooth and glabrous over the dorsal surface which is very finely gland-pitted, often with a narrow band of yellow below the hyaline tip succeeded by violet. *Wool* completely absent. *Rhachilla* smooth and glabrous, produced beyond the uppermost floret and carrying a rudimentary floret. *Anthers* 0·5–0·8 mm. long. *Palea* scabrid on the keel in upper third, ciliate below.

Ind. Or.: Sikkim, Wallanchoon, 3–4,000 m., *J. D. Hooker* (Type); North-east Sikkim, 1893 *Cummins*; Lachung 3,500–4,000 m., 30 Aug. 1849, *J. D. Hooker*; Morray Samdang, 2 Sept. 1849, *J. D. Hooker*; Phusum, 3,000 m., *Bor et Kiratram* 19936.

This species was treated in the Flora of British India as a variety of *Poa annua* L. with which it has little in common. It can easily be distinguished from *P. annua* by the 3-nerved lower glumes, firmly chartaceous lemmas which are broader and by the palea which is ciliate on the keels below but scabrid in the upper third. The anthers are 0·5–0·8 mm. long. The panicle-branches at maturity are often reflexed.

8. **Poa stapfiana** Bor, in Kew Bull. **1949**: 239 (1949).

P. tremula Stapf in Hook. f., Flor. Brit. Ind. **7**: 344 (1896) non Lam.

A perennial, stoloniferous grass with leafy culms and fibrous roots. *Culms* up to 60 cm. tall, erect or geniculate at the base rooting at the basal nodes, 5-6-noded, the lower close, the upper widely separated, terete, smooth and glabrous, striate. *Leaf-blades* 5–14 cm. long by 1–5 mm. wide, at the top often much less, tapering gradually or abruptly to a sharp point; flaccid or occasionally firm, the upper as long as or longer than the subtending sheath, glabrous, distinctly toothed on the cartilaginous margins, smooth or minutely scabrid on the upper surface. *Sheaths* covering the nodes, rather loose, smooth and glabrous, scarious below, striate, the lower slipping from the internodes and disintegrating into pale yellow fibrous threads; the shape of the line of junction of leaf and sheath is an inverted U. *Ligule* up to 5 mm. long, hyaline, rounded.

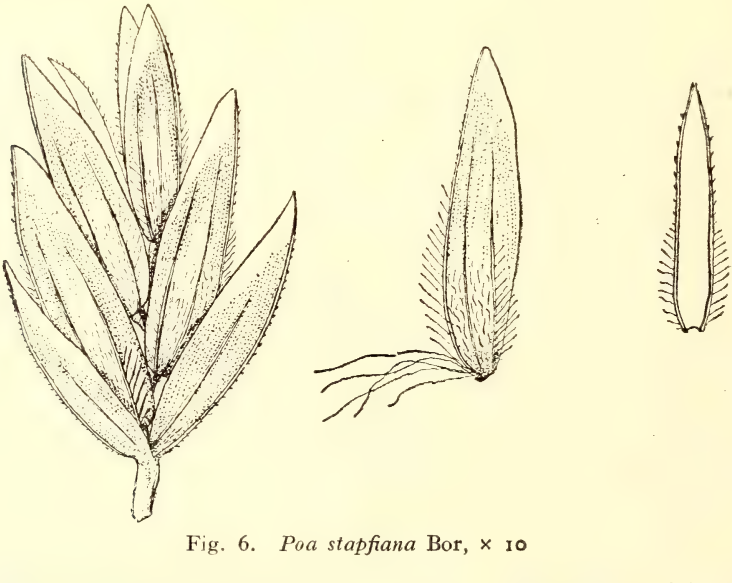


Fig. 6. *Poa stapfiana* Bor, × 10

Inflorescence a lax, loose, widely spreading, pyramidal panicle up to 25 cm. long; axis smooth and glabrous, stout at the base, filiform at the tip; branches long and flexuous, lowest binate, very rarely 1- or

3-nate, up to 15 cm. long, smooth or nearly so, glabrous, capillary, loosely branched towards their tips; branchlets rough, glabrous, carrying a few short pedicelled spikelets. *Spikelets* elliptic-oblong, 4–6 mm. long, 3–5–6-flowered, crowded at the tip of the branches, green or somewhat glaucous in colour. *Lower glume* rather variable in length, 2·75–3·75 mm. long, 1–1·5 mm. wide, oblong-lanceolate, elliptic-oblong or even lanceolate-acute or acuminate, gently curved on the back, normally definitely 3-nerved but 1-nerved lower glumes are often found, hyaline at the tip and narrowly so along the margins, glabrous, coarsely scabrid on the keel in the upper half, and on the terminal portion of the lateral nerves. *Upper glume* 3–4·5 mm. long, 1·5–1·75 mm. wide, oblong-, elliptic- or even oblanceolate-acute or -acuminate, slightly curved on the back when seen in profile, glabrous, 3-nerved, coarsely scabrid on the keel in the upper half and occasionally on the side nerves. *Lowest lemma* 3–4·5 mm. long, sometimes, though rarely, suffused with purple, with a yellow streak at the tip just below the hyaline portion which is very definite and may extend to one-eighth of the length of the lemma, oblong-obtuse when flattened, erose at the tip, dorsal surface glandular-punctate, ciliate on the keel to the middle and scabrid above, ciliate on the lateral nerves, with many or few silky hairs on the dorsal surface in the lower half; succeeding lemmas similar, diminishing in size. *Wool* definite, copious or scanty. *Rhachilla* hairy, produced beyond the uppermost fertile floret and surmounted by a rudimentary floret. *Anthers* 1–1·5 mm. long. *Lodicules* 2, very small, unequally 2-fid, sometimes up to 1·5 mm. long. *Palea* 2·5 mm. long, 6 mm. wide, lanceolate-oblong in shape; keels rather long ciliate in the lower half, covered in the upper half with prickles diminishing in length from below upwards and finally reduced to short antrorse teeth, occasionally lower half with longer teeth than those in the upper half and not definitely semi-pilose.

Ind. Or.: West Himalaya; Boope Valley, *Jacquemont* 277; Dharamsala, Laka, 3,700 m., *C. B. Clarke* 24414; Nepalia, *Wallich* 3798; Kashmir, Upper Sind Valley, 28 Sept. 1848, *T. Thomson*; Ladak, Leh, 4,000 m., 1856, *Schlagintweit*; Manali, 2 Aug. 1941, 3,700 m., *N. L. Bor* 15575.

The long panicle branches bare at the base and the silky lemmas are very characteristic of this species.

—— var. **micranthera** Bor, comb. nov. *P. tremula* var. *micranthera* Stapf.

The variety is typical *P. stapfiana* Bor except for the very minute anthers. Since variability in the length of the anthers is a very rare phenomenon in the Himalayan *Poae*, none in the present review apart from this variety having been found, a special study of the variety was made in order to find out whether characters specifically different from the type exist. As already stated, however, it is not possible to separate the variety on any character except the size of the anthers.

Ind. Or.: Kashmir, Palgam, 4 Sept. 1876, 3,900 m., *C. B. Clarke* 31057; Pahlgam, 4 Sept. 1876, 4,000 m., *idem* 31061; Tilail, 23 Aug. 1876, *idem* 30667.

Lahul, Rotang, 11 July 1941, 4,000 m., *N. L. Bor* 9806.

II. HIMALAYENSES

9. **Poa himalayana** Nees *ex* Steud., Syn. Pl. Glum. 256 (1854).

A tufted grass, slender when annual, stouter when perennial. The perennial has a slender rhizome. *Culms* very smooth and glabrous, terete, 0·5–1 mm. in diameter below the panicle. *Leaf blades* linear, up to 15 cm. long, 2 mm. wide, scabrid on both surfaces, becoming smooth with age, very scabrid on the margins, often hairy on the rounded base where the blade joins the sheath, flat, flaccid, glabrous. *Sheaths* tightly fitting, old often loose, scarious, slipping from the culm, smooth and glabrous, not covering the nodes. *Ligule* up to 2 mm. long, often rough or hairy on the outside.

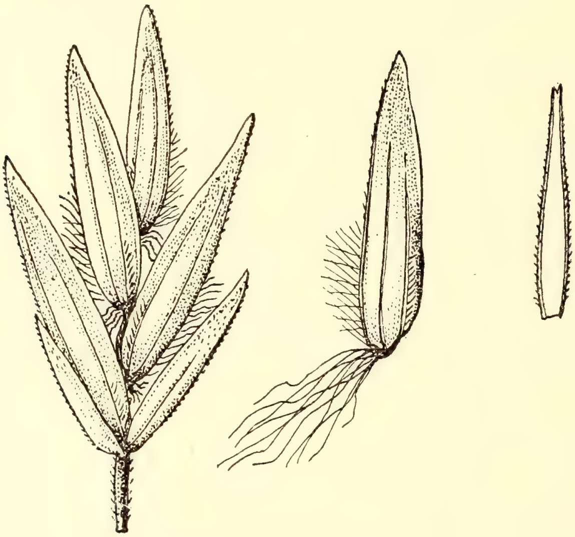


Fig. 7. *Poa himalayana* Nees, × 10

Inflorescence a panicle, often lax, with widely spreading branches, up to 16 cm. long, 8 cm. broad ; rhachis of the panicle glabrous and smooth ; branches in twos, up to 3 cm. without branching, scabrid ; branchlets scabrid, sparsely rebranching. *Spikelets* narrowly oblong, 4·5–6 mm. long, 3-flowered, occasionally only 1-flowered. *Lower glume* 2·25–2·5 mm. long, 0·5 mm. wide, awl-shaped in profile, lanceolate-acuminate in shape when flattened, 1-nerved, slightly curved on the back, scabrid on the keel and on the dorsal surface near the tip, very narrowly hyaline on the margins. *Upper glume* 2·75–3·5 mm. long, 1 mm. wide, lanceolate- or narrowly ovate-acute in shape when flattened, 3-nerved, scabrid on the keel and side nerves especially towards the tip, very narrowly hyaline on the margins. *Lemma* 4–4·5 mm. long, 1·5 mm. wide, conspicuously 5-nerved with nerves reaching nearly to the margin, long-ciliate on the lower half of the keel, scabrid above, shortly ciliate in the lower portion of the lateral nerves, very narrowly hyaline along the margins and at the tip or not hyaline at the tip, very glabrous between the lateral nerve and keel, but dorsal surface finely pitted or surface scaberulous. *Wool* present, often fairly copious. *Rhachilla* joints long up to 1·5 mm. long, continued as a slender stipe up to 2 mm. long, crowned with a rudimentary spikelet. *Anthers* 0·75–1 mm. long. *Palea* 3 mm. long, narrowly elliptic in shape, armed on the keels with very fine antrorse teeth.

Ind. Or.: Nepalia: 1821, *Wallich* 8885 (Type); Sikkim: Lachen, 3,000 m., 11 June 1849, *J. D. Hooker*; Sandhakphu, 2,600 m., May, 1894, *C. B. Clarke* 35029; Sandhakphu, 4,000 m., July 1881, *Gamble* 9052; Phusum, 3,500 m., 25 June 1945, *Bor et Kiratram* 19915. Tibet: Chubitang, 4,000 m., 22 June 1945, 'in marshes in fir forest', *Bor et Kiratram* 19647.

This is one of the commonest grasses in Sikkim above 3,000 m., but it has been much confused in the past. The description of it given by Hook. f. in the Flora of British India is quite misleading, for it is based in part upon a closely related, but quite distinct, species, namely, *P. stewartiana* Bor. For a discussion upon the differences between these two species the reader is referred to *Kew Bulletin*, 1951, 181.

10. **Poa stewartiana** Bor, in Kew Bull. **1951**: 185 (1951).

A delicate annual grass. *Culms* very slender, smooth and glabrous, somewhat striate, glabrous at the nodes. *Leaf-blades* linear-acuminate, green, flaccid, rounded at the base to the sheath, flat, minutely scabrid on the margins, especially towards the stout tip, smooth and glabrous on both surfaces, up to 15 cm. long, 3–4 mm. broad, uppermost leaves as long as or shorter than the subtending sheath. *Sheaths* tight, smooth and glabrous, striate, longer than the internodes. *Ligules* milky, membranous, 2·5–3 mm. long.

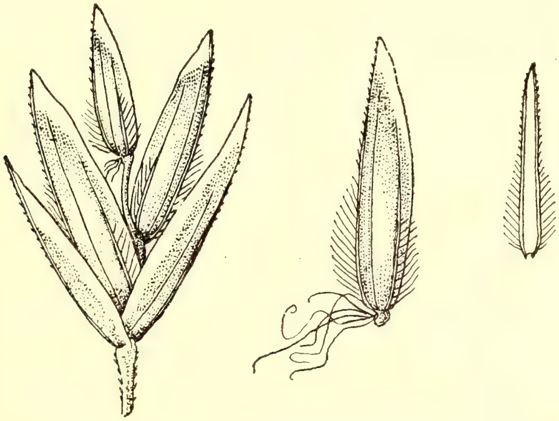


Fig. 8. *Poa stewartiana* Bor, × 10

Inflorescence a weakly spreading, often nodding panicle up to 20 cm. long, 10 cm. broad or even larger; axis angled, capillary, very minutely scabrid or scaberulous or even smooth, striate; branches in pairs, erect, spreading or finally deflexed, flexuous, scaberulous, bare for 3–4 cm. and then rebranching and carrying a few spikelets at the tips. *Spikelets*

3–5 mm. long, broadly elliptic when young, wedge-shaped when old, 3–4-flowered. *Lower glume* 2·5–3 mm. long, 0·75–1 mm. wide at the widest parts, lanceolate-acuminate in shape when flattened, awl-shaped in profile, curved on the back, 1-nerved, smooth and glabrous except on the keel in the upper half which is scabrid. *Upper glume* 2·5–4 mm. long, 1–2 mm. wide, oblong-acute or oblong-elliptic-acute, 3-nerved, straight on the back in profile in the lower two-thirds then gently curving towards the tip, hyaline on the margins, smooth and glabrous, except for the scabrid upper half to the keel. *Lemma* 2·5–3·5 mm. long, 1·75–2 mm. wide, oblong-elliptic-acute, 5-nerved, smooth and glabrous on the dorsal surface, ciliate on the keel in the lower half and on the marginal nerves or the latter glabrescent, hyaline on the margins, coarsely scabrid on the keel in the upper half. *Rhachilla* smooth. *Wool* copious. *Stamens* 3. *Anthers* yellow, 1 mm. long. *Palea* shorter than the lemma, strongly 2-keeled, ciliate on the keels in the lower half, scabrid above.

Ind. Or.: N. W. India; Jaunsar, 2,000 m., 5 May 1897, *Duthie* 19777, 'in forest' (Type); wet rocks on old Mahasu road, 2,300 m., 25 June 1878, *J. S. Gamble* 6,237A; Bussahir-Kunawar, 1885, *J. F. Duthie*. Kashmir, Tragbol, 3,200 m., 19 July 1876, *C. B. Clarke* 29244; Gulmarg, 3,000 m., July 1926, *R. R. Stewart* 8675. Near Simla, June 1889, *J. F. Duthie* 10137; Simla 27 Aug. 1849, *T. Thomson*; Punjab, *J. R. Drummond* 21362.

For a discussion regarding the merits of this species vis-à-vis its closest relative *P. himalayana* Nees, the reader is referred to *Kew Bulletin* 1951, 181.

11. **Poa khasiana** Stapf, in Hook f., Flor. Brit. Ind. **7**: 343 (1896).

A tall, slender, loosely tufted, perennial grass without rhizomes. *Culms* up to 70 cm. tall, smooth, terete, erect or somewhat geniculate at the base, rooting at the nodes, clothed at the base with a few loose, scarious, membranous sheaths. *Leaf-blades* linear, tapering to a rather sharp point, up to 20 cm. long by 3 mm. wide, flat, flaccid, or the shorter ones rigid, minutely scabrid on the upper surface, smooth below, glabrous, smooth on the margins, becoming very scabrid towards and at the tip; midrib and lateral nerves strongly marked. *Sheaths* smooth and glabrous, rather loose on the culm, very loose at the base, longer or shorter than the leaf. *Ligule* very short, not more than 1 mm. long, erose.

Inflorescence a pyramidal panicle with horizontal branches and few spikelets, nodding when young, rather contracted, branches subsequently spreading or standing at right angles to the stem; lower branches 3–5-nate, scaberulous to the base, branched; branchlets very short, scaberulous, carrying only a few spikelets, often only one; axis smooth and glabrous below, scaberulous above. *Spikelets* usually 3-flowered, oblong-elliptic in shape when young, wedge-shaped at anthesis. *Lower glume* 2–2·5 mm. long, 1 mm. broad, slightly curved on the back, lanceolate-narrowly-elliptic or oblong-acute in shape, glabrous, sparsely gland-dotted on the dorsal surface, 1-nerved, narrowly hyaline on the margins, minutely rough on the keel in the upper half. *Upper glume* 3–3·5 mm. long, 1·5 mm. wide, elliptic-acute or oblong-ovate-acute when flattened, 3-nerved, slightly curved on the back, glabrous, coarsely scabrid on the keel in the upper half, on the dorsal surface in the upper quarter and on the side nerves. *Lemma* 3–4 mm. long, 1·5 mm. wide, oblong-obtuse in shape, conspicuously 5-nerved, side nerves running almost to the top which is very shortly hyaline, narrowly hyaline on the margins which are distantly toothed, whole of the dorsal surface glandular-punctate, ciliate on the keel in the lower half, scabrid in the upper half, ciliate on the marginal nerves, on the whole of the dorsal surface almost glabrous, occasionally with the most minute scabridities in the lower half of the dorsal surface. *Wool* absent or scanty. *Rhachilla* with 3 joints; in a typical instance, 1, 1·25–1·5 mm. in length, the uppermost slender and carrying a rudimentary spikelet, rather warty. *Anthers* 1 mm. long or just under. *Lodicules* 1-toothed. *Palea* 2·75–3·75 mm. long, scabrid on the keels.

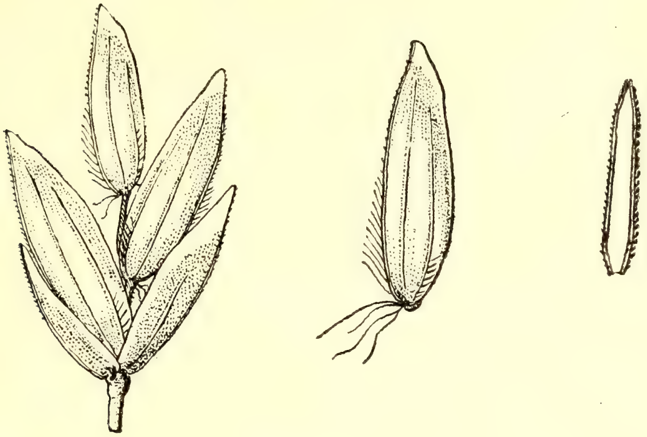


Fig. 9. *Poa khasiana* Stapf, × 10

Ind. Or.: Khasi Hills; Cherrapunji, 2,000 m., 18 June 1850, *J. D. Hooker* (Type); Shillong, 1,500 m., 17 April 1886, *C. B. Clarke* 43383 ; Maflang 1,500 m., 2 July 1850, *J. D Hooker*; Shillong, 2,000 m., 2 May 1943, *N. L. Bor* 17392.
Naga Hills; Thekubnma 2,300 m., 18 June 1935, *N.L. Bor* 4460.

This grass bears some resemblance to *Poa pratensis* Linn., particularly in those specimens which have connecting wool. There are, however, no rhizomes, the lowest branches are 2-nate not 5-nate, and the lemmas are smoother and more glabrous. The amount of wool is variable and occasionally almost absent. It is a much more robust plant than *Poa himalayana* Nees, which it also resembles. If a spikelet of each be examined, however, it will be found that the tip of the lower glume in *P. himalayana* does not exceed the mid-point on the keel of the lowest lemma. In *P. khasiana* the tip of the lower glume does overlap the mid-point of the lemma. Moreover, the lemmas in *P. khasiana* are shorter than those in *P. himalayana* and give the spikelet a different appearance.

This species is found inside forests and along forest margins and in moist shady places generally.

12. **Poa wardiana** Bor, in Kew Bull. **1948:** 143 (1948).

A slender grass, probably perennial. *Culms* up to 35 cm. tall, straight, rather weak, somewhat decumbent at the base, scabrid below the panicle, smooth and glabrous elsewhere; internodes longer than the sheaths; nodes smooth and glabrous. *Leaf-blades* up to 8 cm. long, 2 mm. wide, soft and flaccid, green, minutely scabrid above and below and on the margins, linear, abruptly contracted to the hooded tip, shorter than the subtending sheath. *Sheaths* rather tight, smooth and glabrous, striate, the old sheaths clothing the base or slipping from the culms. *Ligules* truncate, lacerate, 1·5 mm. long.

Inflorescence a rather delicate panicle; lower branches long, flexuous, scabrid, bare from 2–3·5 cm., branching; branchlets carrying a few spikelets at the tips. *Spikelets* oblong-elliptic in shape, 4·5 mm. long, 2–3-flowered, the florets diverging at anthesis. *Lower glume* 2·5 mm. long, 0·8 mm. wide, oblong-acute in shape when flattened, rather thin, 1- occasionally 2-nerved, smooth and glabrous, except on the keel which is scabrid, slightly curved on the back, flushed with purple. *Upper glume* 2·5 mm. long, 1·2 mm. wide, ovate lanceolate- or elliptic-acute, slightly curved on the back, 3-nerved, narrowly hyaline on the margins, suffused with purple near the tip and/or along the margins, smooth and glabrous except for the scabrid keel. *Lemma* 3 mm. long, 2·5 mm. wide, broadly oblong-obtuse when flattened, prominently 5-nerved, coarsely scabrid on the dorsal surface as well as on the keel and nerves, otherwise glabrous, hyaline at the tip and along the margins, sparsely ciliate on the keel towards the base. *Wool* absent. *Rhachilla* smooth and glabrous, joints rather long, prolonged beyond the topmost floret and carrying a rudimentary floret. *Stamens* 3; *anthers* 0·75 mm. long, purple. *Palea* of the topmost floret longer than its lemma, it and the others coarsely toothed on the keels, scabrid on the flaps and between the keels.

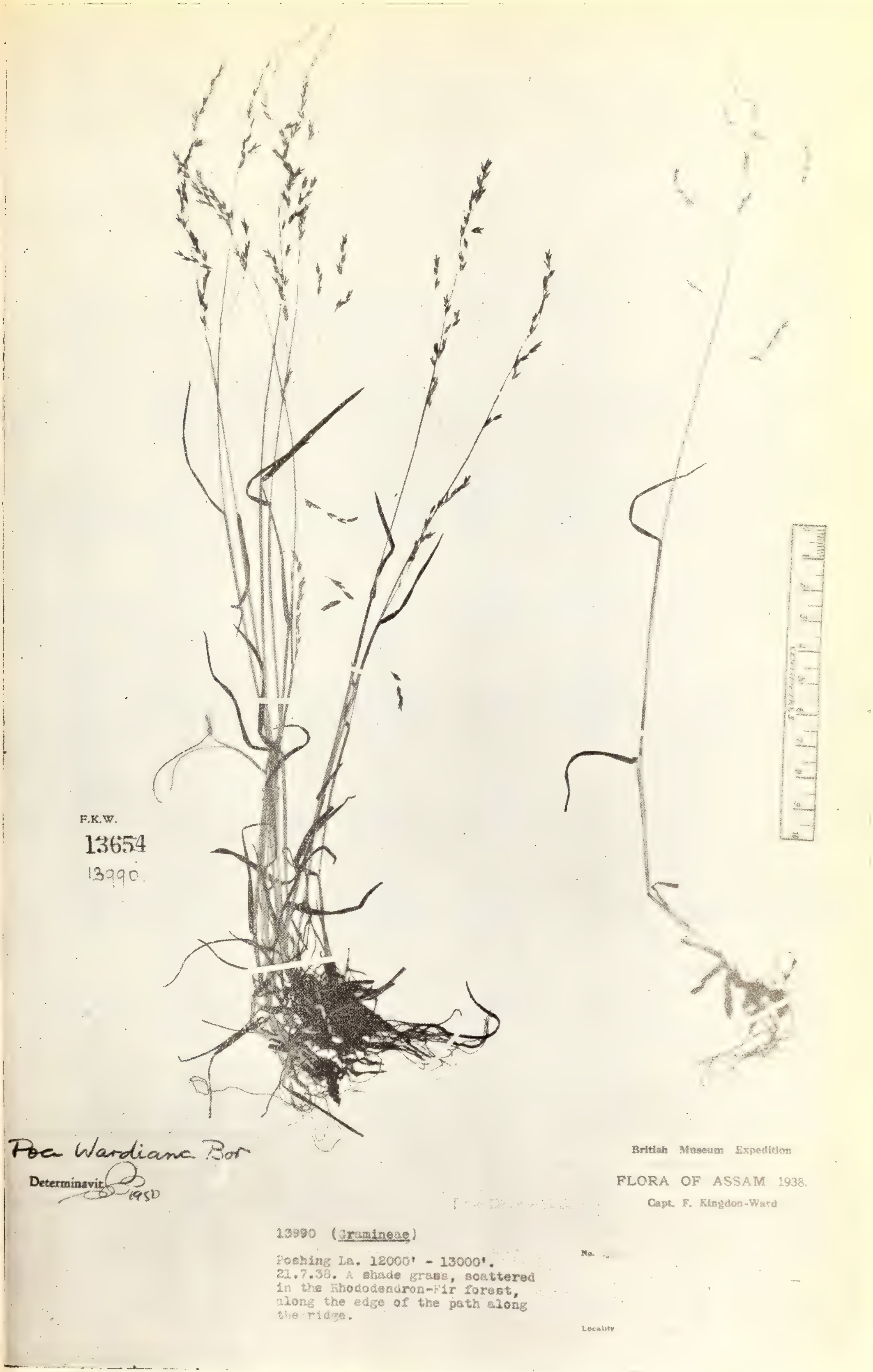
India: Assam, Balipara Frontier Tract, Poshing La 3-4,000 m., 21 July 1938, *Capt. F. Kingdon-Ward* 13990. 'A shade grass scattered along the path in Silver Fir-Rhododendron climax'.

This species is extremely like *P. himalayana* superficially, but can be readily separated from it by the culm being scabrid under the panicle and by the absence of wool at the base of the lemmas. The lemmas themselves, moreover, are very scabrid, as also is the palea on the flaps and between the keels.

III. NEMORALES

13. **Poa nemoralis** Linn., Sp. Pl. ed. 1, 69 (1753).

A perennial forest grass with short stolons, reaching a height of 80 cm. and forming loose assemblages. *Culms* usually erect but often rising from a weakly geniculate base, very slender, very smooth, glabrous, terete, rather weak. *Leaf-blades* linear-acuminate, narrow, not more than 2 mm. broad, tapering to an acuminate tip, up to 20 cm. long, but usually much shorter, the topmost not more than 10 cm. long, longer than the subtending sheath, strongly contracted at the base to the sheath, rough on both surfaces and on the margins, rather soft, bright



13990 (Gramineae)

Poshing La. 12000' - 13000'.
21.7.38. A shade grass, scattered
in the Rhododendron-Fir forest,
along the edge of the path along
the ridge.

Poa wardiana Bor

green. *Sheaths* rather tight, but slipping from the culm at the base, smooth and glabrous. *Ligule* often entirely absent, at the most a narrow membranous annular ring, not more than 0·5 mm. wide.

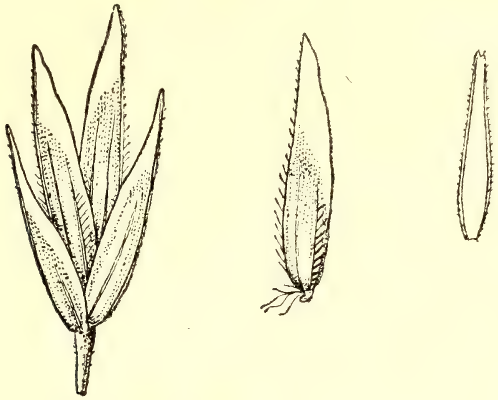


Fig. 10. *Poa nemoralis* Linn., × 10

Inflorescence a very loose panicle not more than 15 cm. long, but usually about 10 cm., with widely spreading branches at flowering time, sometimes nodding ; panicle-branches usually rough, 1–4-nate, loosely branched with branchlets carrying few spikelets up to 4–6 mm. long, narrowly elliptic-acute or lanceolate-acute in shape, green, bright brown or suffused with purple, 2–5-flowered. *Lower glume* 2·5–3 mm. long, 1 mm. wide, lanceolate-acuminate in shape when flattened, awl-shaped in profile, broadly or narrowly hyaline on the margins, 3-nerved, occasionally 1-nerved with a very slender second, slightly curved on the back, smooth and glabrous, apart from the keel which is scabrid. *Upper glume* 3–3·5 mm. long, 1·5 mm. wide, elliptic-lanceolate-acute when flattened, 3-nerved, broadly or narrowly hyaline on the margins, curved and rough on the keel. *Lemma* 3–3·25 mm. long, 1·5 mm. wide, narrowly oblong-acute or sub-obtuse when flattened, 5-nerved, slightly curved on the back, hyaline in its upper quarter and along the margins, ciliate on the keel in the lower half and scabrid in the upper half, ciliate on the marginal nerves, glabrous and smooth in the intervening spaces (or very occasionally puberulous). *Wool* present, often very scanty. *Rhachilla* minutely hairy. *Anthers* 1·2–1·5 mm. long or even a little longer. *Palea* shorter than the lemmas, scabrid on the keels.

Ind. Or.: Kashmir, Burzil Valley, 3,000 m., 18 September 1893, *Duthie* 14067 ; Badarwar Valley, Chenab, 2 June. 1848, *T. Thomson*; Mussoorie, July 1845, *T. Thomson* ; Kumaon, 2,800-3,000 m., 14 July, 1886, *Duthie* 6160; Jaunsar, 2,000 m., June 1892, *Gamble* 23499.

Tibet: Gautsa, 4,200 m., 29 May, *Bor* 19431.

The species which is called *P. nemoralis* Linn. in this revision is that species which I conceive to be true *P. nemoralis* Linn., namely, a species of which the characteristics are a very short ligule, not above 0·5 mm. long, and a lower glume which is 3-nerved, very narrow and acuminate, almost subulate. In the *Flora of British India* var. *Linnaei* Stapf is what is understood by the above. The erection of var. *ligulata* Stapf to cover species with a ligule up to 3 mm. long, introduced an element which is quite foreign to true *P. nemoralis* Linn. A glance through the folders of this variety at Kew revealed that most of the specimens could be referred to *Poa sterilis* M.B., some to *P. araratica* Trautv. and that about half a dozen other species absorbed the remainder.

14. **Poa polycolea** Stapf, in Hook. f., Flor. Brit. Ind. 7: 342 (1896).

A perennial, stoloniferous grass with slender, wiry stems. *Culms* erect, terete, smooth, from a somewhat geniculate or creeping base, up to 30 cm. tall, clothed at the base with many characteristic, scarious, shining, pale straw-coloured sheaths which have slipped from the culm and are persistent ; nodes smooth and glabrous. *Leaf-blades* narrowly linear or subsetaceous, the lower up to 8 cm. long, smooth and glabrous on the upper surface, minutely scabrous below and on the margins, linear-acuminate from an abruptly rounded base. *Sheaths*, apart from the basal, tightly fitting, smooth and glabrous, deeply striate, upper sheath much longer than its leaf-blade. Ligules very short, up to 1 mm. long or a little longer.

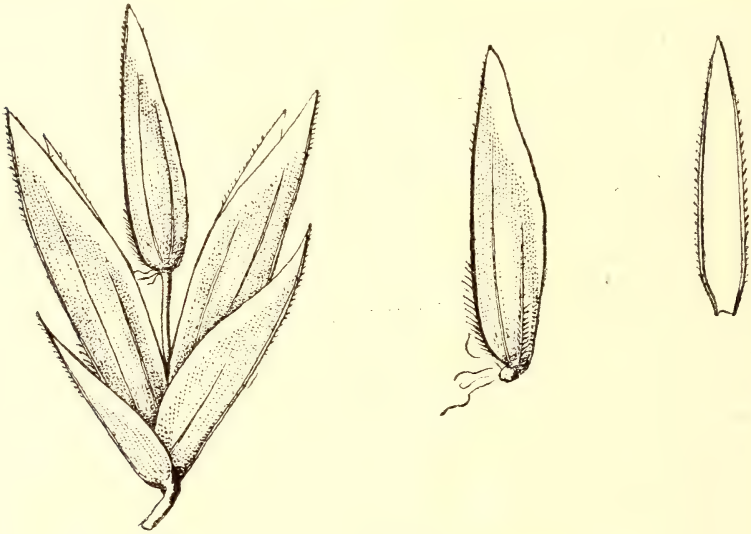


Fig. 11. *Poa polycolea* Stapf, × 10

Inflorescence an effuse panicle, sometimes more or less contracted, seated on a long, exserted peduncle, 5–10 cm. long, nodding or erect; branches whorled, the lower in groups of 2–5, flexuous, slender, smooth, usually carrying spikelets in the upper half only, as a rule only branched to the first degree, and then more often giving rise to a whorl (up to 3) scabrid branchlets which are ultimately spiculate. *Spikelets* seated on short (up to 5 mm. long) scabrid pedicels, 1–3–4-flowered, pale and somewhat silvery in appearance, often suffused with purple, up to 7 mm. long, elliptic-acute before anthesis, then wedge shaped; florets spreading widely at anthesis. *Lower glume* 2·5–3 mm. or even 3·75 mm. long, 1 mm. wide when flattened, linear-acute or lanceolate-acute or acuminate, awl-shaped in profile, slightly curved on the back, 1-nerved, smooth and glabrous except for the upper half of the keel which is scabrid, hyaline on the margins. *Upper glume* 3–3·5 mm. or even 5 mm. long, 2 mm. wide, oblong- or elliptic- or ovate-acute in shape when flattened, 3-nerved, slightly curved on the back, smooth and glabrous, except for the upper half of the keel which is scabrid, broadly hyaline along the margins. *Lowest lemma* 3·5–5·5 mm. long, oblong-obtuse or elliptic-oblong-obtuse in shape when flattened, slightly curved on the back, 5-nerved (nerves inconspicuous when the spikelet is young but become prominent afterwards), rather thin in texture, broadly hyaline along the margins from the tip, gland-pitted all over the dorsal surface, scabrid along the nerves and on the dorsal surface to almost smooth, silky-ciliate on the outer nerves and along the keel in the lower half or glabrous on all nerves, softly tomentose or (quite) glabrous between the nerves, scabrid on the keel in the upper half; succeeding lemmas gradually shorter in length. *Wool* absent or very scanty. *Rhachilla* glabrous and smooth, minutely gland-pitted, long-jointed, the second joint being often 1·5 mm. long, the final joint often the longest and carrying a rudimentary spikelet. *Anthers* 2–2·5 mm. long. Lodicules 2, unequally 2–toothed. *Palea* 3·5 mm. long, 0·75 mm. broad, narrowly elliptic, keels smooth in lower third and upper sixth, intermediate space with small antrorse hooks.

West Himalaya: Valley north of Chamba, 3-3,500 m., *Hook. f. et T. Thomson*, no. 15 Poa (Type); Datmir, 2,700 m., *Gamble* s.n.; Kumaon, Dugli 3,500 m., *Strachey et Winterbottom*; Tehri Garhwal, Harke Dun, 3,000 m., 1893, *Gamble* s.n.

Tibet: Yatung, 3,000 m., 10 June 1945, *Bor et Kiratram* 20099.

This is a very distinct species which might be confused with *P. pagophila* were it not for the very narrow, acuminate, lower glume and smooth and glabrous lemmas. The numerous, scarious, straw-coloured, loose, lower sheaths are also characteristic.

15. **Poa aitchisonii Boiss.**, Flor. Orient. 5: 602 (1884).

A tufted, perennial grass with many fibrous roots. *Culms* geniculate below, rooting at the nodes, finally erect, reaching a length of 30 cm., slender, smooth and glabrous, leafy, covered at the base with the scarious remains of old sheaths. *Leaf-blades* linear, shortly tapering to the short tip, contracted at the base to the sheaths, flat, green, somewhat flaccid, up to 10 cm. long by 4 mm. wide, scabrid on both surfaces and sharply scabrid on the margins, midrib rather prominent and carried down on the sheath as a rather indefinite keel. *Sheaths* smooth and glabrous when old, the young sheaths covered with a very short pubescence, rather loose and slipping from the culms, more or less keeled. *Ligule* about 1 mm. long, lacerate.

Inflorescence a rather narrow panicle, up to 9 cm. long by 5 cm. wide, rather contracted at first, then spreading; axis smooth and glabrous, angled; branches in pairs, erect at first, then spreading at anthesis almost at right angles to the stem, smooth and glabrous, becoming scabridulous towards the spikelets and branching, bare at the base, branching once or twice and then the branchlets few spiculate; distance to first forking of the branch up to 2·5 cm. *Spikelets* 4–5-flowered, crowded at first, wide spreading at anthesis, shining; florets widely opening, seated on very scabrid pedicels. *Lower glume* 3 mm. long, 1 mm. wide, awl-shaped in profile, 1-nerved, with a slender second or third nerve, hyaline on the margins, lanceolate-acute when flat, scabrid on the keel and on the upper half of the dorsal surface, hyaline on the margins, leaving a narrow band of green tissue around the median nerve. *Upper glume* 3·5 mm. long, 1·2 mm. wide, lanceolate-acute, almost acuminate in profile, 3-nerved, hyaline on the margin and scaberulous over the dorsal surface in the upper third. *Lemma* 3·5–3·75 mm. long, 1·5 mm. wide, oblong-obtuse, conspicuously 5-nerved, entirely glabrous on the dorsal surface including the nerves, scabrid or shortly ciliate on the keel and minutely scaberulous on the dorsal surface, very minutely granular all over the dorsal surface, hyaline at the tip and along the margins. *Wool* at the most consisting of one or two hairs. *Rhachilla* smooth and glabrous, long-jointed, produced beyond the uppermost floret and carrying a rudimentary spikelet. A sample measure of the joints from below upwards gives the following result in mm.: 1, 1, 1·5, 1. *Anthers* 2–2·5 mm. long, *Palea* nearly 3 mm. long, narrowly elliptic-oblanceolate, scabrid on the keels.

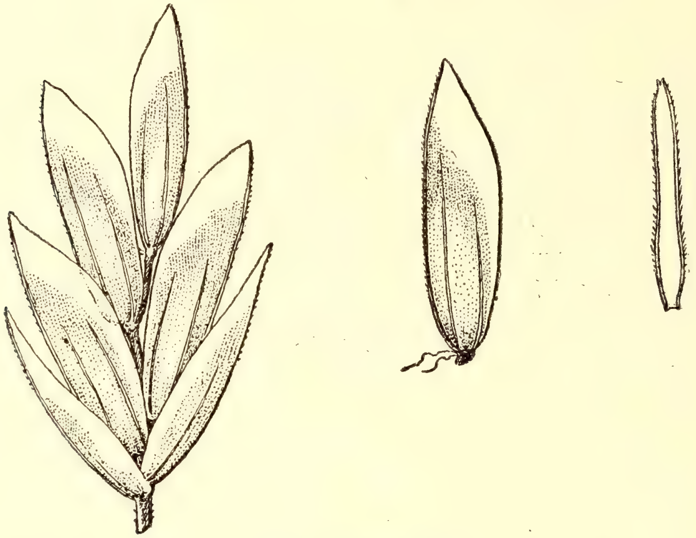


Fig. 12. *Poa aitchisonii* Boiss., × 10

Ind. Or.: Kurram Valley, Aina Mela, 3,000 m., 20 April 1894, *Harsukh* 14934; Waziristan, Pir Ghal, 17 May 1895, 2,500-3,500 m., *Duthie* 15604; Northwest India, *Wingate*.

Afghanistan: Barre Kot, Olipore, *Griffith*, 206.

This very leafy species can only be confused with *P. polycolea* Stapf, from which it differs in the completely glabrous glumes and the much wider leaves. It has also, quite unjustifiably, been mistaken for a leafy robust *P. annua* L. The perfectly glabrous lemmas, large anthers and scabrid keels to the palea are quite sufficient to separate them at once. This is a common grass in Afghanistan, Waziristan and no doubt in other parts of Northwest India.

IV. SETULOSAE

16. **Poa setulosa Bor,** in Kew Bull. **1948:** 142 (1948).

A slender, tufted, perennial grass. *Culms* up to 16 cm. tall, slender, erect or slightly geniculate below, glabrous, scabrid below the inflorescence, 2–3-noded, usually clothed at the base with a few loose old sheaths. *Leaf-blades* much longer than the sheaths, linear, up to 7 cm. long, 1·5 mm. wide, abruptly contracted to a stout point, scabrid on both surfaces and on the margins, flat, sometimes folded, flaccid, reflexed or spreading. *Leaf-sheaths* rather tight, somewhat rough glabrous, striate, hyaline on the outer margin, glabrous. *Ligules* membranous, up to 3 mm. long, lacerate on the upper margin.

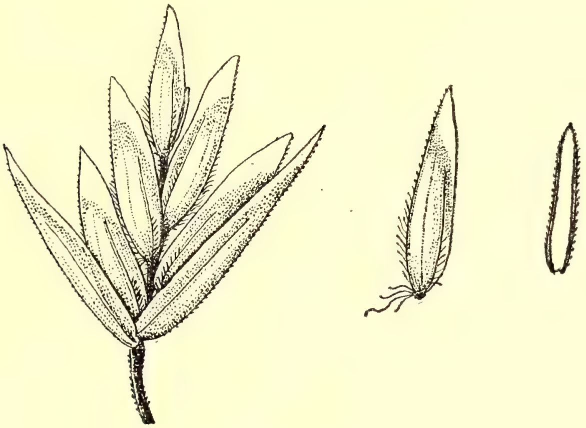


Fig. 13. *Poa setulosa* Bor, × 10

Inflorescence a narrow panicle up to 9 cm. long by 5 mm. broad. sometimes nodding, usually erect; branches 1–2-nate at the base, up to 2·5 cm. long, bare below, carrying few spikelets, very scabrid; rhachis angled, scabrid. *Spikelets* wedge-shaped, 4·5 mm. long, 4–5-flowered. *Lower glume* 3.5–4 mm. long, 0·8 mm. wide, awl-shaped in profile, long-acuminate, straight on the back, almost setulose at the tip, very narrowly hyaline on the margins, 3–nerved, scabrid on the keel. *Upper glume* 3·75–4 mm. long, 1 mm. wide, 3-nerved, straight on the back, narrowly hyaline on the margins, linear-acuminate in shape, awl-shaped in profile, scabrid on the keel. *Lemma* 2·75–3 mm. long, 1 mm. wide, oblong-obtuse in shape when flattened, upper quarter hyaline, margins narrowly hyaline, long-ciliate on the keel in the lower half, scabrid on the keel above, ciliate on the marginal nerves, inconspicuously 5-nerved, punctate but glabrous on the dorsal surface. *Wool* scanty but distinct. *Rhachilla* with a few hairs. *Anthers* 0·6–0·75 mm.

long. *Palea* 2 mm. long, rather shorter than the lemma, oblong in shape, scabrid on the keels.

Ind. Or.: West Himalaya, Kunawar, 15 August 1847, *T. Thomson* (Type).

A delicate species with a long ligule. The glumes are remarkably long in comparison with the lemmas and are almost setulose.

(*To be continued*)

THE FLIGHT OF EAGLES

BY

C. H. DONALD

(With three plates)

When I received an invitation from our editors to write a note on Eagles for the *Journal* for this, its fiftieth birthday, I accepted with the greatest pleasure for well did I know what joy was in store for me. Would I not be going over some of the happiest days in my life in which eagles, falconry and the Bombay Natural History Society were all inextricably woven into a glorious background of the vast virgin forests of Bhadarwa and Kashmir, where I seemed to be the little tin god in command of a world of forest coolies, with plenty of leisure on my hands?

I had already embarked on falconry in the plains of India and had been most fortunate in securing the services of two old *bāzdars* (falconers) who had served my father in Hissar, during the troublous times of 1857. It was impossible to live long in the company of such enthusiasts without being bitten to the bone with their craze. They were brothers and rejoiced in the names of Jhanda and Balunda, respectively. White-bearded old Jhunda, who said he was not yet quite seventy, usually stayed behind and looked after my team of falcons, and incidentally did most of the training, while *little* Balunda—a mere boy of some 50 odd summers—accompanied me everywhere and was my constant companion and *ūstad* or tutor. With eyes like one of the falcons on his wrist, that man missed nothing which flew or ran, and from him I learnt lessons which have stood me in very good stead for over half a century, of how to recognise the different birds of prey by their flight, almost as far as you could see them. With a few tips from Balunda I soon discovered the process as not only interesting, but amazingly simple. It just came, and gradually you found yourself recognising at a glance, confidently, bird after bird as it flew past or soared high up in the sky.

One day the supreme test came; we were up at about 11,000 ft. and above tree level, when Balunda came to a stop and said in awed tones, 'Sahib, what is that?'

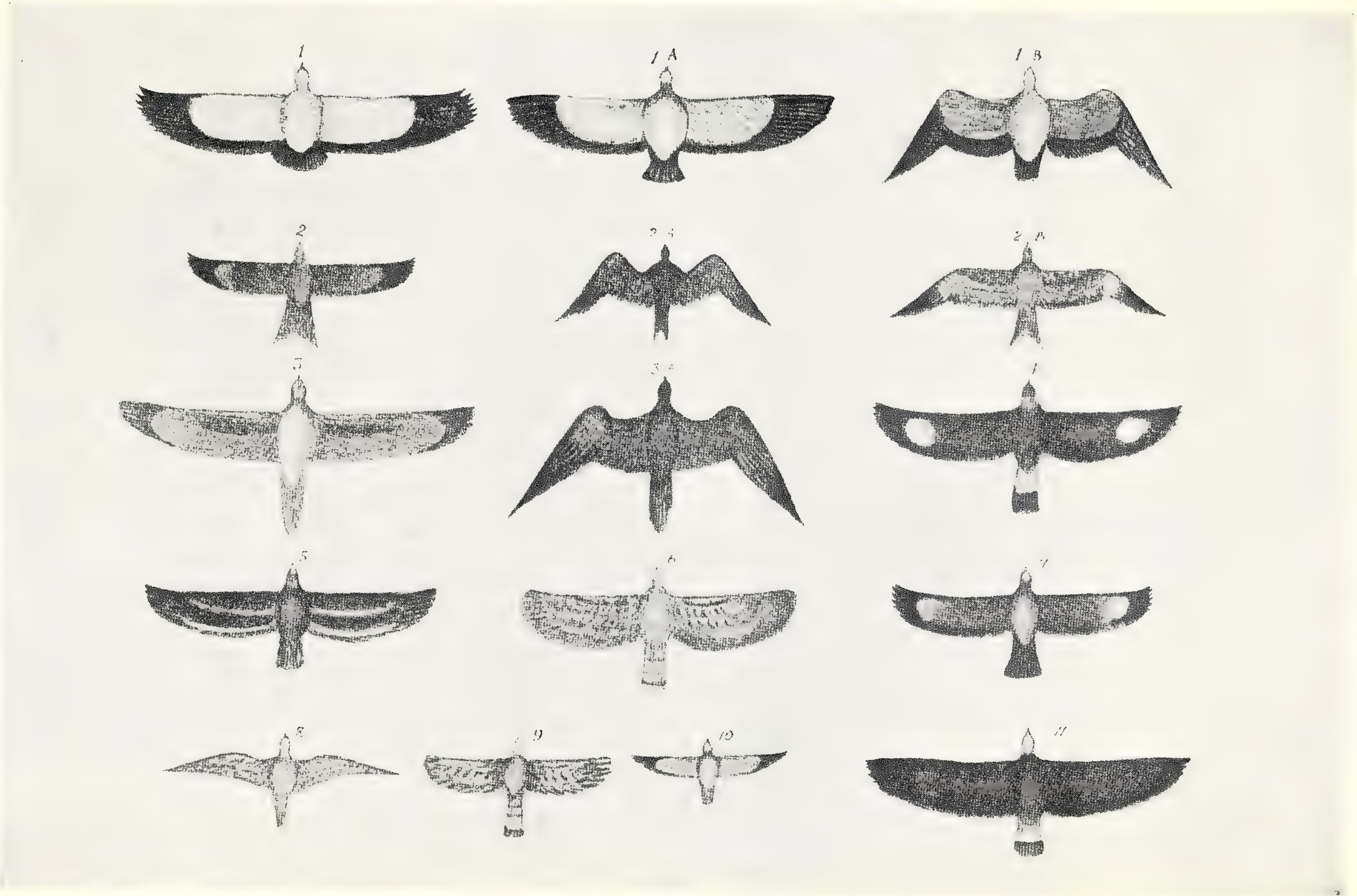
I followed his gaze and there, a thousand feet or so above us soared a huge bird on motionless pinions. '*Burra Jūmbiz* !' I exclaimed, unable to think of anything else for a very dark and large bird. 'No, no, Sahib, that is no *Jūmbiz* but a mighty hunter which I have never seen before.'

I marvelled. The old man admitted he had never seen the bird before yet recognised it as a mighty hunter, a thousand feet above him. I looked and looked again. I had seen that bird before many times, in different localities but now for the first time saw what Balunda meant. The flight was entirely different to that of the *Jūmbiz* or

Imperial Eagle. Forceful and resolute, yet light and buoyant. 'Balunda, call him down and I'll shoot him and find out what it is.' 'That is easy, Sahib. You get in under that bush and I'll have him down in a couple of minutes.' Out came Balunda's ubiquitous bag and from it he extracted a dead pigeon, a lure composed of crows' wings attached to some 10 ft. of string. Then taking the falcon on his wrist he removed the hood and placed the bird on a conspicuous boulder and rushed back to hide under a bush to my right. Next he threw out the lure, giving the customary call for the falcon to come and bind to it, which she did immediately, and Balunda proceeded to draw her in, still holding the lure, which made her flutter not a little. None of this drama was lost to those all-seeing eyes up in the sky. 'He is coming, Sahib', whispered Balunda, a fact I had noted for myself a few seconds previously. The falcon saw her danger and picking up the lure flew under Balunda's bush just as I fired at the black ball descending at umpteen miles per hour. No. 1 shot did the trick, and the great bird fell with a dull thud, dead, where the falcon had been a couple of seconds before.

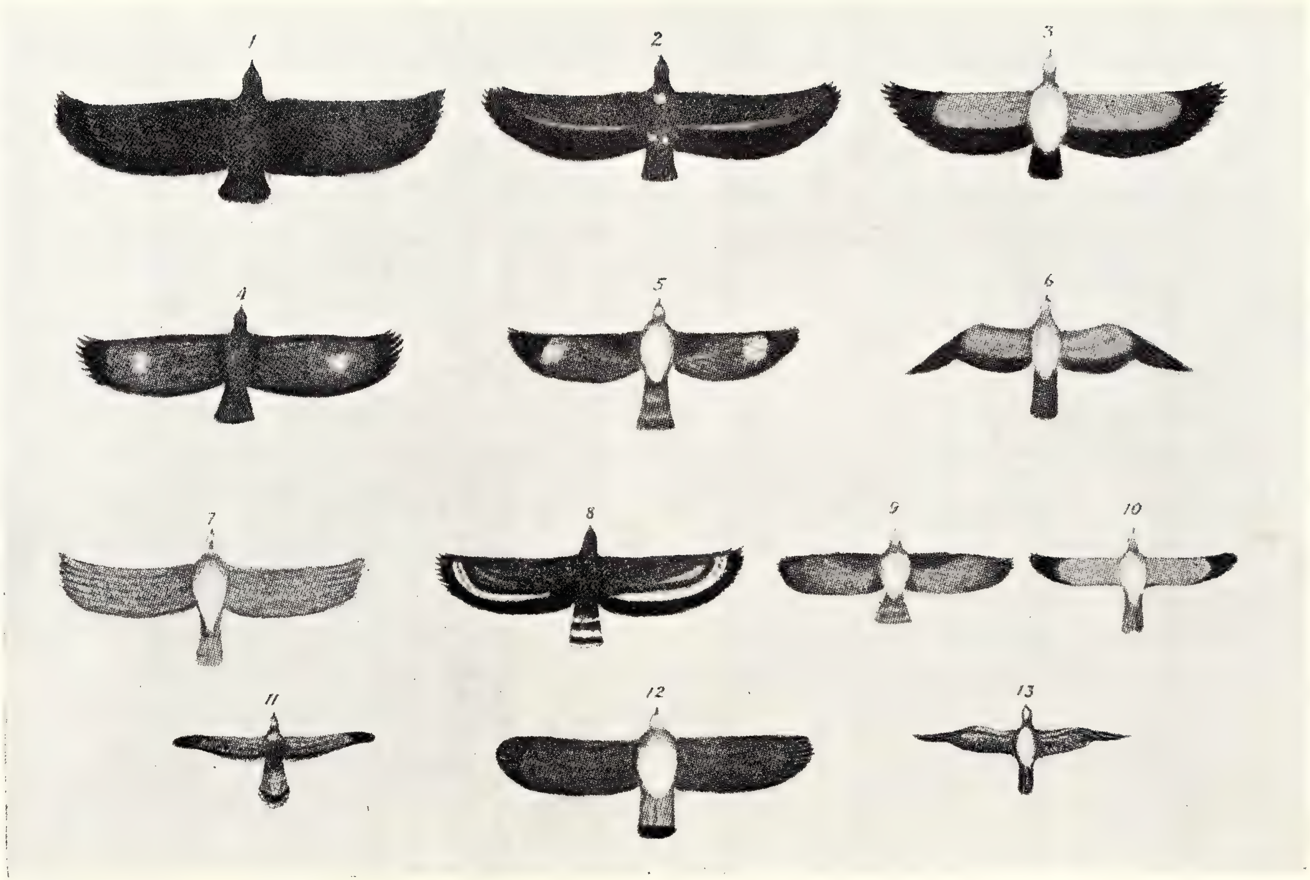
Balunda rushed to it, turned it over, and pointed to the enormous foot and claws. 'Did I not say he was a great hunter, Sahib? That bird could kill a sheep or even a man.' 'This must be the bird the shepherds call a *Muriari* of which I have heard a lot in the last few months,' said Balunda, and I too had heard a good deal of its depredations among the shepherds' flocks. But as time went on and I persisted in my search for correct information, the assertions of its killing sheep and lambs became more and more vague; and in some 50 years of wandering all over the Himalayas I do not think I met with more than half a dozen men who had *actually seen* this eagle attack a sheep, though I had myself seen one kill a tahr.

We wrapped him up in Balunda's sheet and made for camp where the eagle was skinned and filled with moss and lichen, and on the following morning the skin was on its way to Bombay. A long week of suspense and, at long last, a reply from the Hony. Secretary, acknowledging receipt of the 'lovely skin' and informing me that the bird was an Imperial Eagle. How could I break this to Balunda, the more especially that after a few talks and explanations from him as to the flight of the bird, to say nothing of those claws, I was now very much of his way of thinking. By return post I replied and thanked the Hony. Secretary for his letter and asked for another examination, as I was sure the bird was *not* an Imperial Eagle whatever else it might be. Back came a reply that a committee of the leading ornithologists, then in India, had gone carefully over the bird and come to the unanimous conclusion that the bird *was* an Imperial Eagle. This was getting serious, so what should we do next? I again replied very politely and asked if it would be possible to send the bird to the Natural History Museum, London. It went, and three months later came the reply: 'The bird is a young Golden Eagle in transition stage of plumage.' Good old Balunda! He had the unfailing key to the identification of accipitrine birds—Flight. A falconer, born and bred from many generations of men who had watched every phase of flight, and had not confined themselves to their hawks and falcons.



Diagrams by C. H. Donald

Some Birds of Prey
Diagrammatic impressions of overhead flight
(*For explanation see end of article*)



Diagrams by C. H. Donald

Some Birds of Prey
Diagrammatic impressions of overhead flight

Now it must not be supposed that I have written the above introduction merely to praise Balunda, but when I quote from a well-known book, which many members must have read, a paragraph which completely misled me, and must have similarly put off many a young tyro like myself, thirsting for knowledge, it will be conceded there is some method in my madness. The paragraph reads :—'As far as I am aware this bird is of such excessive rarity in the Himalayas, south of the snows, as scarcely to deserve a place in our lists. Every so-called Golden Eagle which has as yet been sent to me, has proved to be *A. imperialis* in the dark 3rd stage of plumage.' The author had, at Kotgarh (Simla Hills), a regular establishment for shooting and preserving birds, from which he received over a thousand specimens and who had special injunctions to shoot all large eagles. From them he apparently received several Imperial Eagles but not one single Golden.

Later he modifies the above in his 'Nests and Eggs', Vol. III, pp. 130-131, by saying 'the Golden Eagle occurs and breeds sparingly in the Himalayas from Sikhim to Afghanistan. In the eastern and central portion of this tract it is confined to the immediate neighbourhood of the snowy ranges, but in the extreme N.W. it comes nearer down towards the plains.'

Another well-known ornithologist once wrote to inform me that in 20 years collecting his collectors had never found a Golden Eagle in Kashmir. Some months later I happened to be in Srinagar, and paid a visit to the museum, and the very first thing, on entering the door, I was confronted by was a magnificent specimen of a female Golden Eagle, in its first plumage, labelled *'Aquila heliaca: The Imperial Eagle. This bird sometimes catches Chikor.'*

Further comment seems superfluous, except to emphasise the fact that if an illiterate old man is able to identify a bird which he has never even seen in his life, at about 1,000 ft. above him, as a mighty hunter and *not* an Imperial Eagle, it is obvious there must be something in his system of identification which is entirely lacking in the make-up of most good ornithologists; and that something is the key in the study of the birds of prey, viz. their *very distinctive flight* which varies considerably from the one to the other of the various species.

All Indian falconers are extremely good at recognising birds on the wing, but Balunda had made of this hobby a fine art, and in the five years or so he was with me I never lost an opportunity of asking him what any particular species that might be passing at the time was, and, as a rule, his reply came pat without the least hesitation, but very occasionally he seemed to look very carefully before replying and in such cases it was generally *Astur badius* or *Accipiter nisus* that caused the slight momentary doubt in his mind, and that only when the light was against him, and no colouring or markings could be seen.

I would not like to say that this method is infallible, but it is certainly 95% correct, and where it goes wrong is probably due to the specimen in hand rather than the system, as aberrant specimens are by no means unknown among the Raptores, and a very obvious Tawny Eagle in the air might turn out to be a Steppe in the hand, or vice versa; extremely rare, I should say, but just possible.

The keys given in Blanford and Oates's Fauna of British India—Birds, and Stuart Baker's more recent revision of the same, cannot well be improved on, and in my paper in Vol. xxvi, No. 2 (pp. 629 *et seq.*) of the *B.N.H.S. Journal*, I have used the above keys freely. With that paper are also two charts showing different birds in flight, which, I have been told by many members, have been of great service to them in identifying birds of prey. The reprints of these papers were, at the time, sold by the Society, and if still available, I would certainly recommend their careful study, to anyone keen on taking up these birds as a hobby[1]. Not being an artist in any way, I can lay no claim to beauty of execution, but if they are clear enough to depict the differences in overhead flight between the various species, the papers and the charts will have served their purpose.

I am told the real 'headaches' are the Imperial Eagle (*Aquila heliaca*), the Steppe Eagle (*Aquila nipalensis*) and the Tawny Eagle (*Aquila rapax*). With the possible exception of an abnormal specimen turning up, I should have said off-hand, that these three are among the easiest to separate. Let us take each species separately. Each species has two very different phases of plumage, a very light brown to deep umber brown which in the Imperial is almost verging on black in the adult bird; and there are many shades in between.

1. **The Imperial Eagle** (*Aquila heliaca*). In the young or lineated stage, whether the overall colouring is light brown or very dark brown, there are always lines of darker brown spots running down the full length of the breast and front of the bird generally.

In the adult stage the whole plumage, i.e. the background is very dark brown almost black. The head is white or whitish changing to buff on the nape and a few odd pure white feathers are visible on the scapulars and back. A white bar on the tail completes the set-up of this species.

2. **The Steppe Eagle** (*Aquila nipalensis*). Whether the overall plumage be dark or light brown, it is always uniform on the breast and never lineated or spotted in any way, thus it can never be confused with the Imperial Eagle in its young (lineated) plumage or in fact at any stage. In this species there is a light bar, or often two, running the whole length of the wing made by the upper and lower faded wing covert tips. These bars are always visible and a distinctive feature of the bird.

3. **The Tawny Eagle** (*Aquila rapax*). General colouring not unlike the Steppe Eagle whether in the light or dark phase, but the Tawny lacks the white bars on the wing and is an *altogether smaller* bird, with a tarsus measurement of 2½" to 3" as against 3½" to 4" in the Steppe. Length of Steppe Eagle might easily exceed that of the Tawny by five or six inches, and the wing span of the latter is noticeably less.

It is, however, in the two last species that 'headaches' might be caused by aberrant specimens, as I am of the opinion, perhaps quite erroneously, that very occasionally they *may* interbreed. I have seen, on one occasion, a Steppe Eagle carrying sticks to the nest whence I had just previously caught a Tawny. I also on one occasion shot what I was sure was a Tawny, on a high pass in Kulu, on the migration

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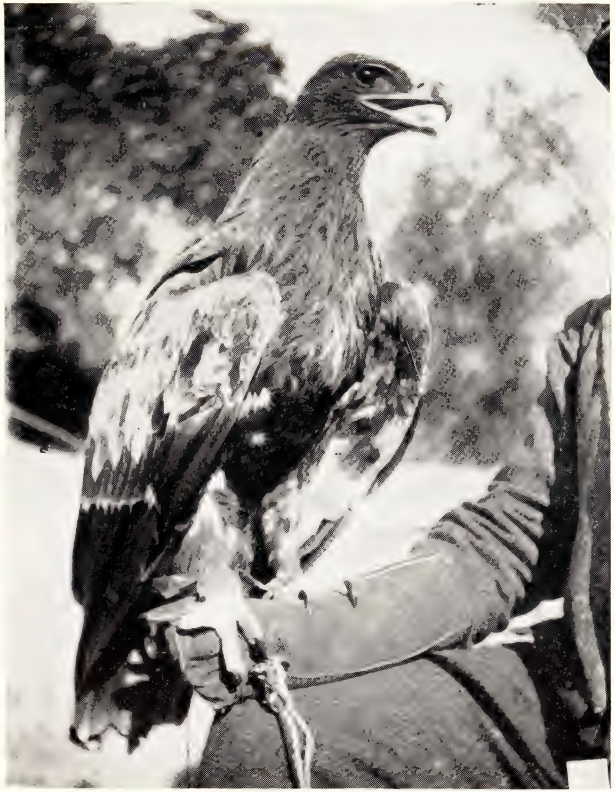
[1] The charts are reproduced herewith. Reprints of the papers are unfortunately no longer available.—Eds.



Photos

A Steppe Eagle

Author

Golden Eagle (2 years old) taken from nest 10 miles from Kotgarh, Simla Hills.

route of the Steppe and Imperial Eagles, but this is pure conjecture and not worth considering, though it might be worth looking out for.

If this very short paper will induce some of our young and keen members to take up seriously a study of the flight of birds it will not have been written in vain.

BIRDS OF PREY IN OVERHEAD FLIGHT

Explanation Of Diagrams

Plate I

No. 1, 1 A, 1 B—Griffon Vulture. 1 B a young bird.
Note the tail in each. (Wings broad, tail short)

No. 2, 2 A, 2 B—A Kite.
Note wings and tail. (Wings ample, tail long and *forked*)

No. 3, 3 A—The Lämmergeier (adult and young).
Wings long and rather narrow ; tail long, wedge-shaped.

No. 4—A Golden Eagle (young plumage).
Wings long, tail long. Wings held very straight and well upwards ; tertiaries meet body above root of tail and form conspicuous triangle with it.

No. 5—A Steppe Eagle.
Two parallel lines along ample wings, tail medium ; wings not always very straight ; held in the same plane as body ; tertiaries do not make a prominent triangle with tail as in No. 4.

No. 6—A Hawk-eagle (*Spizaëtus*).
Wings short and broad ; tail long. Wings held well upwards.

No. 7—A Buzzard.
Wings rather rounded, long ; tail medium to long ; half moon in wings always present; tail frequently spread,

No. 8—A Falcon.
Wings long and pointed ; tail medium.

No. 9—A Hawk.
Wings short and rounded ; tail long.

No. 10—A Blackwinged Kite.
Wings long, pointed ; tail medium. From below practically pure white with black tips to primaries only.

No. 11—Pallas's Fishing Eagle.
Wings long and often bent ; tail medium, half white and half black ; head whitish. Remainder of plumage practically jet black.

Plate II

No. 1—The Cinereous Vulture.
Wings very broad, tail short ; colour uniform throughout.

No. 2—The Black Vulture.

Wings broad, tail short; white crop and thigh patches faint whitish line along the wings.

No. 3—The Whitebacked Vulture.

Wings broad, tail short; body and tail brownish black; a broad white band across wings. *The body is wrongly shown as whitish in the diagram.*

No. 4—The Large Spotted Eagle.

Wings rather broad, tail medium; colouring black, streaked and patchy; white patches on wing.

No. 5—Bonelli's Eagle.

Wings ample, tail long; body white, streaked; tail greyish brown, slightly barred; wings dark grey with white patches.

No. 6—The Booted Eagle.

Wings ample, frequently bent; tail long, unforked; body and front of wings dirty white, tips of wings, margins and tail dark brown to black.

No. 7—The Short-toed Eagle.

Wings ample and broad, tail long. Colouring throughout, pale greyish, often silvery; a dark streak near chin and another on or near first primary.

No. 8—The Crested Serpent Eagle.

Wings broad, tail medium. Colour varies from reddish brown to deep brown. A broad wing stripe and two often visible on tail white or whitish.

No. 9—The Brahminy Kite.

Wings rather broad, tail medium. Head and body pure white, slightly streaked, wings reddish with black tips, tail reddish, upper parts bright chestnut.

No. 10—A male Hen Harrier.

Wings long, slightly rounded; tail long. Colour white or bluish white throughout except for tips of primaries, which are black.

No. 11—A Kestrel.

Wings long and narrow, not very pointed, tail long. Colour light brown, streaked, wings lighter than body. In males the tail is bluish with a black band near the end.

No. 12—Hodgson's Fishing Eagle.

Wings broad, tail medium, neck and breast brownish, body white tail brown mixed with white; wings dark brown.

No. 13—A Hobby.

Wings long and pointed, tail medium. Body white, wings and tail dark brownish grey, speckled with white.

A HISTORY OF SHIKAR IN INDIA

BY

LIEUT.-COL. R. W. BURTON, Indian Army, (Retd.)

(*With four plates*)

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INTRODUCTION

The India of our subject includes the whole sub-continent, also Burma and Ceylon. We have to pass in review the Indus Valley flanked by the Kirthar, Baluchistan and Suleiman Ranges and then see Kashmir and adjacent territories of Baltistan, Ladak and Changchenmo, Zaskar, Rupshu, Spiti and Lahoul all of which are a vast entourage of snowy mountains, riven ravines and precipices; of plateaux and lofty ranges which remain an everlasting wall between India and the rest of Asia.

'*Northwards soared the stainless ramps of huge Himala's wall.*'

Where the mountains have a northern aspect they are usually forest covered, while the southern slopes and folds of the hills are often bare and dry, subject to forest fires and the depredations of domestic flocks and herds.

> '*Lower grew the rose oaks and the great fir groves where echoed pheasant's call and panther's cry.*'

Continuing east we pass over the wooded and often mountainous tracts of the Simla Hill States, Garhwal and Kumaon until we meet the five hundred mile long exclusive Kingdom of Nepal. Then we see Sikkim and the dense forests of Bhutan, which have been almost unknown to British sportsmen of the past and present alike, until we arrive at the northern part of Assam, so often devastated by earthquakes. Here we may remark that the animals of the Eastern Himalayas resemble those of the Burma region, while along the mountains to the westward are kinds more akin to those inhabiting the temperate parts of Asia. Passing over Burma, Tenasserim and the Malay Peninsula we view Java and Sumatra and then turn west for Ceylon. Within that enormous arc is the Peninsular India with which our subject largely deals.

What is sport?

It can be said that all sport is governed by unwritten laws, and the general tendency is to give the animal a sporting chance of escape, also to make the sport as great a test as possible consistent with the object in view—the death of the quarry. It may also be defined as measured by difficulty in achieving success.

THE PRE-MOGUL PERIOD

The physical aspects of the Indus valley have undergone many changes. No longer are there the forests which provided timber for the first Indus flotilla constructed by Alexander in 325 B.C.; gone are the rihinoceros and the elephant; gone are the swamp deer, and the last tiger was shot in 1886. Hog-deer, wolves, chinkara, wild dogs, jackals, hares, cats, and the hyena very rarely, now comprise the larger animals of the Indus valley. The Indian Antelope (Blackbuck) has been introduced into the Khairpur territory.

In the early Jain and Buddhist periods (*c.* 600 B.C.) there was considerable knowledge of mammals, birds and reptiles, but previous to the appearance of the Emperor Babur on the scene there is little information concerning shikar.

THE MOGUL PERIOD

From 1526 to 1707 much of interest is contained in the memoirs of the Mogul Emperors and the chronicles of European travellers in India in those times. The famous illustrated copy of the Ain-i-Akbari, bearing the signature of the Emperor Jehangir, in the Victoria and Albert Museum should be seen by all who can do so. In the series by Sálim A. Ali on 'The Mogul Emperors as Sportsmen and Naturalists' we learn about the hunting methods practised in those days; and this is aided by Handley's valuable illustrated article. These two contributions afford a remarkably full picture of the shikar methods and natural history knowledge of the period. The shikar grounds of the Moguls

Photo *Theodore Hubback*

Indian Elephant (*Elephas maximus*)

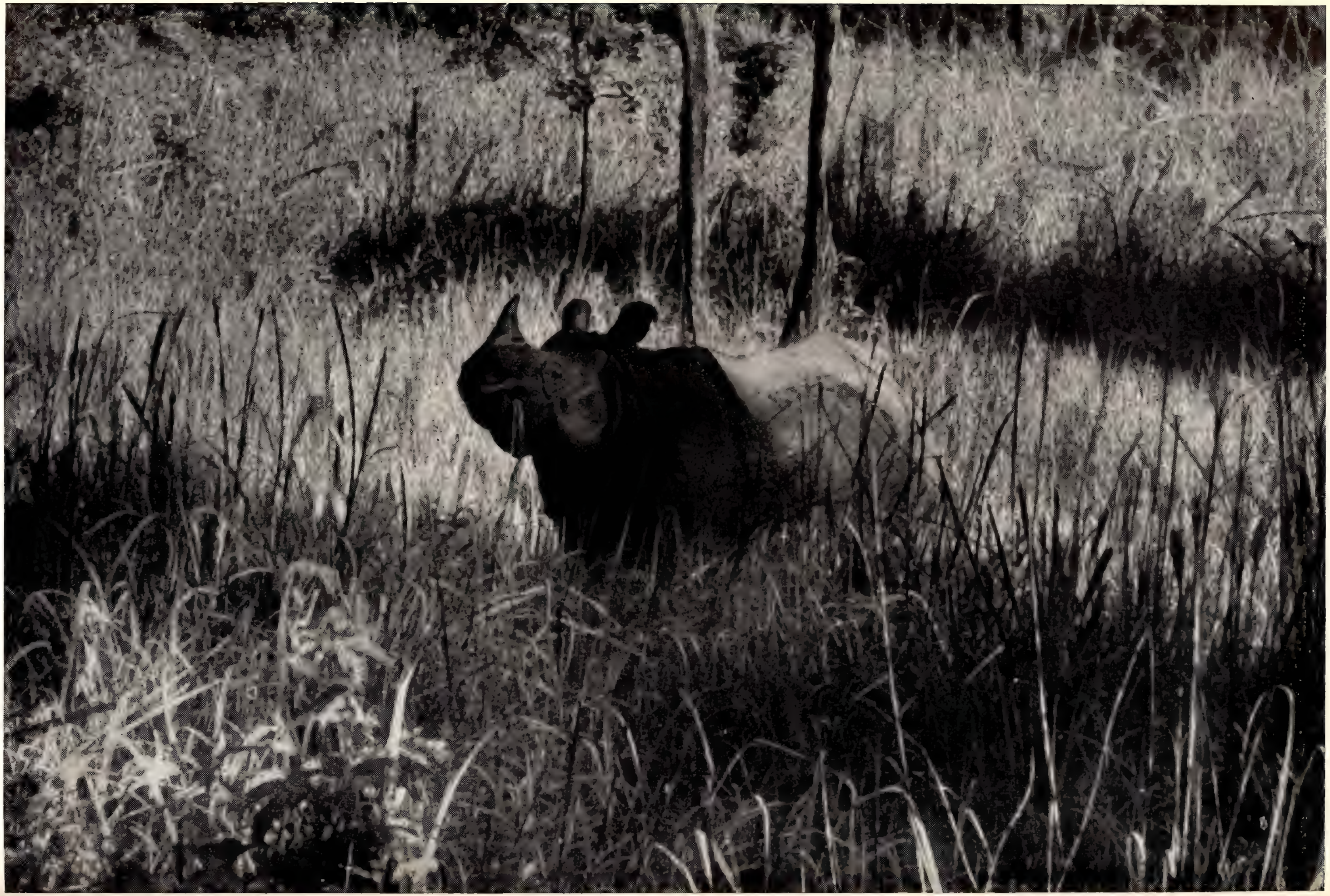

Photo *H. E. Tyndale*

Great One-horned Rhinoceros (*Rhinoceros unicornis*) were the upper valley of the Indus towards Peshawar, and the whole of the present U.P. westward from the Ganges to Kathiawar and southwards to Mandla in the Central Provinces.

THE SHIKAR ANIMALS OF THE MOGULS

Elephant, rhinoceros, buffalo were known to the Moguls, but not the 'Bison'. When the Moguls first entered India in 1526, the rhinoceros was along the Indus, and the elephant in many places whence it has since vanished. Akbar was specially interested in trapping wild elephants. At the present time there are no longer any elephants north of the Dehra Dun Siwaliks; the rhinoceros lives only in Nepal, Bengal and Assam; the wild buffalo in those same areas, while a few herds survive here and there in Orissa, Raipur, Jeypore and Bastar.

The Larger Felines: The Emperor Babur was a fine sportsman, as also was Akbar, while Jehangir excelled as a naturalist. Akbar disliked the less hazardous methods of tiger-hunting—traps, nets, limed leaves. etc.—and preferred to attack these animals openly with bows and matchlocks.

In Mogul days, and as late as the 1830's lions were numerous in Hindustan. Jehangir killed them in Malwa, and the Rev. Terry (*c.* 1650) was frequently terrified by them when passing through the then vast jungles of that country.

The Mogul Emperors quickly discovered the delights of Kashmir, but there is little record of what they did there in the way of shikar. Abul Fazl mentions that the snow leopard was tracked in the snow in Kashmir, but since this is a very elusive animal, seldom seen by sportsmen, it is more likely that this had reference to the common leopard or panther. This is still considered a fine sport by the few who have done it; Ward's series should be seen.

Bears: Of bears there seems to be almost no mention in the Mogul literature.

Deer: Nor do we find much about hunting of Deer in the Mogul days. A net was put round the horns of a tamed deer and the horns of the wild one became entangled. It is related that one of the deer 'caught' a leopard which became entangled in the net. The species of deer referred to is not clear. Another form of hunting was by means of a light inside a basket on a man's head; the animals attracted were shot or speared. The modern poacher uses electric torches or other contrivances and buckshot cartridges.

Antelope and Gazelle: There must have been a very great number of antelope (blackbuck), nilgai and gazelle in all the areas suited to them. All the Emperors, Jehangir in particular, were extremely fond of hunting the nilgai and spared no personal effort in pursuit of sport where this species was concerned. Blackbuck were trained as decoys to take the wild ones by the net method. That same device is in use in a part of South India at the present time.

Hunting with the Cheetah: This is a pastime indulged in by many notables in India since very early days. The Mogul Emperors were partial to the sport, and Akbar kept a thousand of these animals. Three sets were khācăh (' Royal') or for use of the sovereign. The monarch's best leopard, by name *Samand malik* ('like a ruby'), rode in a *chandol*, or litter borne on the necks of two horses.

In a wild state the cheetah hunts antelope, gazelle and the smaller deer, also hares, peafowl and other birds and the smaller mammals, but for sport it is mostly trained for blackbuck. The buck is struck down at full speed, not by blow of a paw only as is commonly stated, but by use of the large-taloned dew-claw which gives the necessary purchase. Blackbuck can attain a speed of 42 miles per hour when hunted and going all out. The cheetah is an animal partial to rocky and open country and was soon shot out when the land became more developed. They were frequently found in packs, and there is record of a cavalry officer having in one day speared six off one horse. The animals having become exceedingly scarce in India, the supply for sporting purposes comes—or used to come latterly—from Africa. The animals have to be trapped when full grown; if taken as cubs the training is tedious and unsatisfactory.

The Caracal—' Siah-gōsh' as the Moguls knew it—is easily tamed, and was trained in the same way to kill gazelle and the smaller deer, foxes, hares, peafowl. Vigne witnessed the sport and says their speed is, if possible, greater in proportion even than that of the cheetah.

Falconry: The antiquity of falconry is known to be very great, and it is certain that the Moguls gave much impetus to the sport in Northern India. In the Sálim Ali series we have something, also in Handley's ' Sport in Indian Art', where we learn that Akbar hunted with trained falcons and hawks of which his favourite was the *bashah* (Sparrowhawk). In the Ain-i-Akbari names of many varieties are given, and the names of those in use in Sind are in Langley's book.

The famous French physician, Bernier, relates of the Emperor Aurangzeb that there passed before him at his daily Court, or Public Audience, ' . . . every species of the birds of prey used in field sports for catching partridges, cranes, hares, and even it is said for hunting antelopes, on which they pounce with violence, beating their heads and blinding them with their wings and claws.'

Fishing: The Mogul Emperors were partial to the ancient sport of fishing, in which connection Sálim Ali and Hora should be seen. It is common knowledge that Muhammadans of the present day all over India are much addicted to angling with rod and line in both rivers and lakes; and there are many anglers in Bengal and other parts of India also.

THE POST-MOGUL PERIOD

Tiger and Lion: Judging by the number of tigers and other game in a seventy by thirty-mile area near Neemuch in the years 1850-1854 as related by Rice, and the mention by Newall of a railway official having killed one hundred tigers in Rajputana owing to the facility with which he could move about, the quantity of game in the time of the Moguls must have been very great. Gordon Cumming takes the modern record to the Tapti river border (in 1862 ten tigers in 5 days); Montague Gerard killed 227 tigers in Central India and Hyderabad before he left in 1903; Prideaux of the Central Provinces shot 147 tigers during his service up to about 1930. Forsyth, Hicks, Glasfurd, Burton and others fill in the period 1845 to 1905 as to the land of hills and plains from the Narbada to the Kistna. For Madras and Ceylon there are Campbell, Hamilton, Sanderson, Samuel Baker, Dawson, Drury, Fletcher and some more.

In regard to Orissa, Bengal, Assam, and Bihar to the Siwaliks we have Williamson, Okeden, Kinloch, Simson, F. W. Pollok, E. B. Baker Fayrer, Baldwin, Braddon, MacIntyre, Adams, Lambert, and others to fill in the hundred years from 1780 to about 1880.

In 1852 a tiger killed an officer of the 98th Regiment 23 miles from Rawalpindi; there was a man-eating tiger near Poona in 1849; and there are interesting records of tigers on the islands of Bombay and Salsette. Owing to increase of cultivation and decrease of forests, tigers are in less number than formerly. Although people are still killed by them in some tracts they are necessary to the forest economy, as are the deer and wild pig on which they are meant to exist, so neither the tigers nor their natural prey should be unduly destroyed by man.

It is said in the *Bengal Sporting Magazine* of 1837 that within 23 years of occupation of the country (after the Mahratta Wars) the lions were extinct in the dry and sandy deserts of the Hariana. In 1832–33 cavalry officers at Rajkot shot lions from horseback; and Colonel D. of the cavalry killed eighty lions while in Kathiawar, one of them being 10 ft. 6 in. long with an 18 inch mane. With another gun (Rice ?) he killed 14 lions in 10 days in the Gir forest. There are now no lions out of Kathiawar, and the number in the Gir is estimated to be 247.

Panther or Leopard: Panthers are more ubiquitous than the tiger and less affected by the advance of cultivation. In proportion, the animal is more destructive than the tiger, and under favourable circumstances is more deadly as a man-eater being more agile and active, also more silent and more stealthy. He climbs better, jumps better, and stalks better than the tiger, and can conceal himself almost anywhere.

Thomas Vigne was in Kashmir in 1835 and his book would be a useful reference were it not so rare and difficult to obtain. Adams was a naturalist and ornithologist rather than a sportsman. From his book, and from Newall and MacIntyre who were also in Kashmir about 1851–52, it is known there was then much game in those countries. Not long after that the writing was already on the wall. Far too many animals were shot by sportsmen; and the people of the country, then as now, took heavy toll during the winter months.

The conclusion from perusal of all the old sporting books, dealing also with Kashmir and Burma, is that the steady diminution of all the game animals began about 1780 as to Hindustan, 1840 as to the Western Himalayas, later as to Burma, and is now nearing its climax unless it is halted by all the governments.

In Williamson's day there was the sport of riding on the neck of a 'koomkee'—a female elephant used as decoy in capturing a male—and throwing a noosed rope round the head of a wild tusker. 'This kind of sport,' says Williamson, 'cannot be classed among the effeminacies of the day!' The hunting by tracking of the rogue elephant was declared by Sanderson to be the greatest of all sports; and is still available from time to time.

Crocodiles: Of the two species of crocodile known in India the river crocodile of the burning ghats and other places takes a man when it has a chance, while the estuarine species is a very dangerous reptile. The Indian Gharial is a fish-eater and not feared by man. Concerning crocodiles and the gharial there are more than fifty Miscellaneous Notes in the Society's *Journal* ; among which harpooning in tanks, gharial catching in the Indus river, hints on shooting crocodiles, angling for crocodiles, and poisoning of crocodiles ! The shooting of these animals in India can be excellent sport and calls for considerable technique and knowledge of the animals. In jungle streams and pools they take considerable toll of wild life. At p. 75, vol. 1 of Langley's book is a visual account by an officer of a tiger being vanquished by a large mugger.

The Sloth Bear and the Malayan Bear : Up to sixty years ago the Sloth Bear was really plentiful all over the forested tracts of India and Assam from the base of the Himalayas to Ceylon. Because of its aggressive habit when chanced upon in the jungle, the hand of man is against it, so it is now almost or quite extinct in places where formerly numerous. Nowhere has it been protected under shooting rules. Many of these bears were speared from horseback by Colonel Nightingale in the 1860's. This noted sportsman died in the saddle in 1868 while spearing a panther. The Sloth Bear will probably survive through protection in some of the National Parks and Sanctuaries in course of formation, and in its more remote haunts. Naturalists regard the Sloth Bear of Ceylon as a distinct race.

The Malayan Bear of Chittagong and Burma is a smaller edition of the Himalayan Black Bear and merits little mention in this history of shikar as it is seldom met with or hunted.

Wild Dogs and Hyenas ; The Indian Wild Dog has an immense range. In earlier days the packs of these animals in forest areas were considerably larger than now. Apart from distemper and other diseases which keep the numbers in check, the fluctuation of the wild dog population must depend considerably upon food supply—mainly deer, pig and other forest animals. Fortunate is it for India that that the species does not attack man, and is not habitually destructive to domestic stock. Should it be more and more deprived of its natural food it may, like the tiger, increasingly prey upon the flocks and herds. The hyena of India is not ordinarily greatly inimical to human life. It is here mentioned as occasionally affording sport to the bobbery-pack, or the horseman with his spear.

Sheep and Goats: When the record Sind Wild Goat (52¾ in.) was shot in the Kirthar Range in November 1912, considerable herds were seen ; of present stock there is no news. In Baluchistan the Persian Ibex may not have survived the influx of modern rifles ; nor will the toothsome Urial have fared better. The Persian Gazelle may have survived in a few places. Of the stock of all these animals in earlier days there is no literature available to the writer, but they probably existed in considerable numbers. The Suleiman Markhor is also an animal of the Baluchistan Hills. Soldier-sportsmen serving trans-Indus used to have fine sport and secure good heads of this race.

In Adams's day ibex were plentiful in Kashmir and Wardhwan ; now they are no longer there, and have not been for a number of years. Only in the more remote nullahs of Baltistan, Gilgit and Astor could the sportsman now hope to find worth while ibex ; and markhor may have almost vanished (Stockley, Vol. 32 ; 783). Both Adams and MacIntyre pointed out in their books what was happening, and what the result would be; while both Baldwin and MacIntyre remarked on the great diminution of game birds in the Terai and the Doon.

SMALL GAME SHOOTING

In his Mogul Emperors series Sálim Ali, being an expert ornithologist, has given us some interesting information. In those days, and up to the period 1840–1860, the game birds of the hills and plains must have been everywhere in great numbers. Nature had evolved for them a high reproduction rate and they were able successfully to contend against all natural checks, and even with the amount of trapping and snaring to which they had been subjected through all the centuries. With the shotgun and its indiscriminate use there came a very great change; but some of this depletion was also due to the increased incentive to the people to snare game for the tables of the foreigners.

Now we have the present intensified diminution of all game birds for there has never been any thought for the morrow, and some species are nearing extinction. During the past few years there has been great opportunity for all game birds to recover in some measure their former abundance, for the changed conditions have made shooting of every description both difficult and expensive. But the apathy of Governments and the authorities, and the activities of trappers and snarers have nullified the opportunity as the demand for meat of any kind has become clamant, and modern communications have made it easy for the supply to reach both markets and consumers.

Failing speedy and suitable measures by Government, the outlook is exceedingly gloomy. Recently, an observer from a foreign land has said to the writer, 'You will lose *all* your game birds.'

Kashmir: Of Kashmir it is reported at the present time that there is depletion of the number of *chukor*. Large bags of wildfowl used to be made in Kashmir by sportsmen inclined that way. One of these shot 6998 duck and geese in one year ; while another, also shooting alone, bagged 58,613 wildfowl in the seasons 1907–1919. He killed 119 grey lag geese in one day, and on another day 509 duck and teal.

Rajputana: In the well-known Bharatpur wildfowl shoots the bags were large. On 20th November 1916 there fell 4206 birds to 50 guns. Without any reference to anything here written or referred to, may be quoted 'Some prefer flighting, others shoot for averages and lose many of the delights of an exceptionally high bird, and there are those who will not pull trigger until three heads are in a straight line !'

In the Imperial Sandgrouse shoots huge were the bags. Perhaps the record may be that of the Bikaner shoot in 1921(?) when Lord Rawlinson was one of the party which killed in two mornings 5,968 birds. May be those large bags of wildfowl could still be made, but the world's wildfowl situation does not warrant such slaughter; and perhaps those other big shoots are events of the past not likely to be repeated, for the times have changed.

In India there is now urgent need for a nation-wide fixed close time for the shotgun from 1st April to 30th September. If enforced, that would do much good; but the trappers and snarers must be dealt with by finding them alternative pursuits, as has been done for the toddy tappers in the cause of prohibition. And the shooting and consuming public must be taught to co-operate by refusing to shoot, buy or eat game birds and wildfowl during that period.

HUNTING WITH A BOBBERY-PACK

The Emperor Akbar was extremely fond of good hunting dogs and imported them from several countries; those from the Hazara District would attack any kind of animal, even the tiger. A bull-mastiff or cross-bred dog of that 60 lb. type will fasten on the nose of the largest of buffaloes, tame or wild, and bring it to its knees within forty yards. In the 1870's Sir Montague Gerard used bull terriers to bring tigers to bay, but discontinued the practice because of inevitable casualties. It is all right to use dogs when following wounded tiger or panther, but too much courage is fatal, and unfair to the dogs.

Sport with a Bobbery-pack has been enjoyed by British sportsmen in India since the early days of the East India Company. Williamson has much of interest—management, feeding, kennels, diseases and care, and kindred matters—which are profitable to us even in these later days. He experienced, as have all who hunt the jackal, the instinctive faculty these animals have of 'shamming death'.

Among modern writers J. W. Best gives an excellent sixteen pages of his small book to the Bobbery-pack; and in the 'Sportsman's Handbook for India' a contributor with fifteen years experience describes his doings and lists jackal, hare, fox, hyena, wolf, blackbuck, gazelle, sambar stag, pig, wild cat and porcupine as having at one time or another fallen victims to his eager dogs. Burton contributes a chatty account 'Days and Doings with my Bobbery-pack' in the Hyderabad country during a number of years. It is essential that the dogs be well broken against 'riot' as to domestic stock; rabies has to be watched for, and there may be casualties from snake-bite.

In these greatly changed days a Bobbery-pack is almost a pleasure of the past, for a general charge of Rs. 3 a dog will not, as in 1904, cover the cost of feed, and the wages of a kennelman would be much more than Rs. 7 a month. The keep of a horse is four or five times as great, and everything else in proportion. Again, and again, *Eheu fugaces*!

HUNTING WITH FOXHOUNDS

When asked what he thought of fox-hunting, the great G.B.S. promptly replied in his own inimitable way, 'It is the pursuit of the uneatable by the unspeakable'!

This essentially British sport has not, for climatic reasons, at any time been universal in this country; but since 1776 when the Madras Hunting Society imported a pack of hounds from England, hunting has gone on uninterrupted in India up to the present day through a Hunt

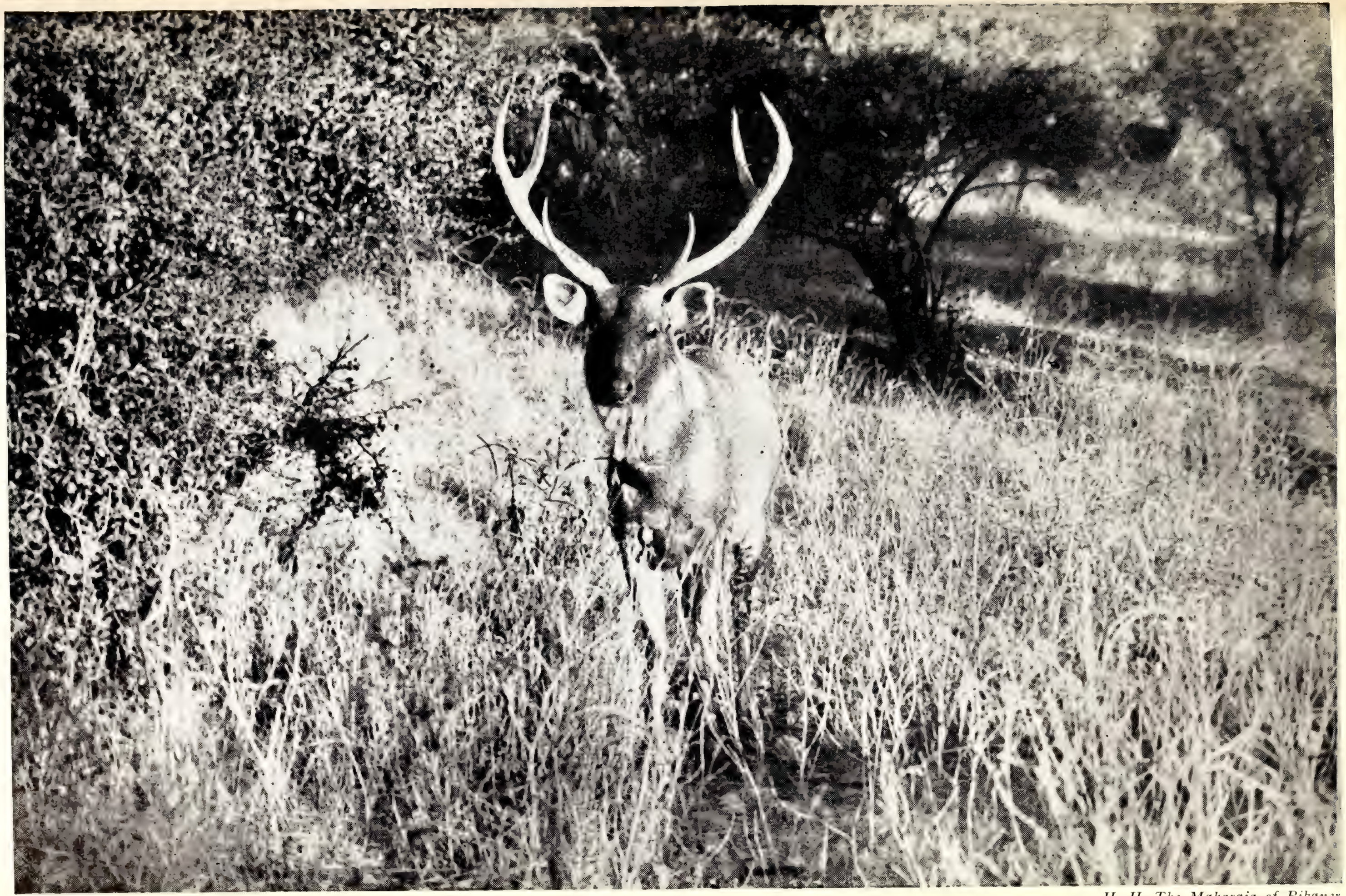

Photo *H. H. The Maharaja of Bikaner*

Sambar or Rusa Deer (*Rusa unicolor*)

The Madras Hunt in Guindy Park, 1866 (From a painting by J. J. Fonseca) being maintained at one time or another in a number of places. The list is a long one: Bangalore, Belgaum, Bombay, Calcutta, Dacca, Delhi, Jaipur, Jaora, Jullundur, Madras, Meerut, Mhow, Mysore, Ootacamund, Peshawar, Poona-Kirkee, Rawalpindi, and perhaps some more.

The Madras Hunt: Unfortunately the continuous records only date back to 1862; but from a letter in possession of Kenel Rigby, Esq., of Meriden Hall, Coventry, it is seen that a 'Hunt Society' existed in Madras as far back as 1776. That most interesting and informative letter is too long for reproduction here. At irregular periods from 1864 to 1875 professional huntsmen were employed. It was Squires of the Pytchley who hunted the Pack during that famous run in 1875 when King Edward VII, as Prince of Wales, was out. One of the characters of the later years of the Hunt was the Kennelman, Charlie, who did 55 continuous years service and remained with the Hunt unil it closed down in 1946. In the Adyar Club are some old records and many group pictures, one of which is reproduced with this contribution. The Bombay '*Onlooker*' for May and June 1940 contains fuller information regarding the Madras Hunt.

The Ootacamund Hunt: Ootacamund was 'discovered' in 1820, and hounds from Madras were kenneled there in 1829. Full information as to the Ooty Hunt is contained in, 'A Centenary Chronicle of the Ootacamund Hunt 1845–1945' by J. F. Smail, M.F.H. Gleanings from the Chronicle:

'The present kennels are easily the best in India, and even compare favourably with the best in England.' . . . 'Hounds have on many occasions been killed by panther, but there is only one record of "riot" after a panther.' . . . 'The ideal type of hunter is a sound, quality horse, not more than 16 hands, with a placid temperament.' . . . 'The ideal hound for Ooty is a large harrier, say 21″ to 23″.' . . . 'It is not the size of the pack, but the quality which tells.' . . . 'I personally prefer a pack of 11 couples to a larger one.' . . . . 'There is no doubt that first class hounds suited to local conditions can be bred generation after generation in India with occasional blood from home.'

4th June 1903 provided the best run that is known—well over nine miles, and one hour and ten minutes. 1913 furnished a sixteen-mile hunt lasting one hour and forty minutes.

Connected with the Hunt is the annual Point-to-Point Race, the Ootacamund Hunt Cup, the Ladies Cup, the Peter Pan Cup. Appendix X of Chronicle gives origin of 121 names of nullahs, sholas, etc., entered on the Hunt Map. The Hunt still flourishes. Long may it continue.

Two Lesser Hunts: When the writer was in Belgaum in 1890 he hunted with Colonel Sherringham's hounds. The Mysore Hunt was in existence during 1932–1936 and showed good sport during May to January on alternative Tuesdays, Thursdays and Saturdays with 30 couple of foxhounds, imported and country-bred. A non-subscription pack of which the Patron was H. H. the Maharajah of Mysore and the Master, Prince Jaya Chamrajendra Wadyar Bahadur.

The Bangalore Hounds: This country was first hunted many years ago by a Bank Manager who ran a very good show in tip-top style at his own expense. He left India and the pack was not kept up. Between 1905 and 1910 the 30th Lancers (Gordon's Horse) ran a useful pack. After a considerable interval the pack was again set going in May 1924 and known as Captain Buckley's Hounds until, in 1929, when the Hunt was well established, the Hounds were purchased by the Bangalore Hunt Club by whom the Hunt was conducted until it closed down in January 1948.

Gleanings from Captain W. H. Buckley's notes:

'Some of our best country is the very best in India and better than most provincial countries at Home.' . . .

'The country-bred hounds have again shown that those who say C. B.'s are mute or small, are liars!' . . . 'A big pack, 30 to 35 couple, is an economy.' . . . 'Due to an equable climate never a case of distemper in seven years.' . . . 'You must have " Music" and for this in Bangalore the Welsh hound is supreme.' (Welsh also asked for by Madras in 1776.)

Bombay: Hunting began in Bombay about 1811, but the Bombay Hunt was constituted in 1865. It has now been combined with Poona and Kirkee and is known as 'The Bombay Hunt and Poona & Kirkee Hounds.' It is distinct from 'The Jackal Club' which has existed since 1889 and is still going strong.

Mhow and Meerut: In 1906, perhaps earlier, and up to 1927 at any rate, there was a pack of foxhounds at Mhow. Later information is lacking.

The Meerut Hunt was formed by Major W. T. V. Wooley, M.F.H. with hounds obtained from the Delhi Hunt before it closed down in 1945. Present strength is 19½ couples, and the M. F. H. is Lieut.-Colonel D. R. Sahni, R.V.F.C. Hound puppies now receive Indian names. Hounds meet every Sunday and bye-days are arranged on holidays. Attendance varies between 25–30 at a Meet; and some members of the Diplomatic Corps come from Delhi—40 miles—to ride with the Meerut Hounds. The present C-in-C in India is the Patron-in-Chief, and but for his active and enthusiastic support and guidance the Meerut Hunt would have closed down.

Peshawar: Hunting was first started in Peshawar in 1863 with 'Hussay's Regimental Pack'. In 1865 the 19th Foot brought their pack, and it hunted during 1865–66 under the name of 'The Green Howard's Pack.' In 1869, on transfer to England, the regiment presented its pack to the Station at Peshawar on condition that it should remain there. The pack then became known in 1869 as 'The Peshawar Vale Hunt' and had its first meet under this name on 2nd February 1870.

The P.V.H. has hunted every season since 1870 with the exception of 1880 when the pack was taken to Kabul during the Second Afghan War. Owing to an unfortunate circumstance the season 1950–51 was the first since 1863—excluding 1880—when there was no pack in Peshawar. In November 1951 hounds were flown out from England under arrangements made by the Pakistan Army. Long may the P.V.H. flourish and show fine sport.

Pigsticking or Hog-hunting

The sport of chasing the wild boar on horseback with a spear was introduced by British sportsmen in Bengal in the latter part of the eighteenth century. At first the sloth bear was hunted; but in 1776 it was the wild boar, the weapon used in the Dacca District being a short, heavy spear three feet long and well poised. It was thrown like a javelin; and if the sportsman missed his aim he had to dismount and recover his weapon, thus letting in the next in succession, and so on till the pig was killed.

The modern spear is up to 6 ft. 3 in., long and fairly heavily leaded —about 1¾ lb. On the Bombay side the spear was eight to ten feet or even more, and often unleaded.

Twenty-five years later a jabbing or thrusting spear was in use in Upper India, but the practice developed in Bengal was to use a spear about seven or more feet in length, also thrown as a javelin as is well described and illustrated in Williamson's 'Oriental Field Sports', 1807. We know from Simson that in 1830 the throwing of the spear was discontinued, and penalized by the Calcutta Tent Club at the instance of Mr. Mills, B.C.S. Published in 1880, Simson's book contains complete guidance to everything pertaining to pigsticking in Eastern Bengal up to that time; and, except as to localities, is of equal value at the present day.

All regarding the sport as developed in Upper India is contained in the article by Neville-Taylor in the 'Sportsman's Handbook for India', with which is a map showing the pigsticking centres and Tent Clubs of those parts in 1904.

'Modern Pigsticking' by Wardrop covers practically all of India and is a complete compendium of pigsticking. The Meerut Tent Club country is fully dealt with; also the Kadir Cup which was constituted in 1869 and the winning of which has been the blue ribbon of pigsticking. Among the hazards related by Wardrop is that of a pigsticker's Arab horse, having swum a river, being seized by the head by a crocodile while drinking in shallow water, dragged into deep water and never seen again; and Kinloch, when hunting with the Meerut Tent Club, had his horse ripped, himself thrown and wounded by the boar in *fifty* places!

The Nagpur country is well described by Best and Dunbar Brander.

Praise of the Boar: 'It can be said that the finest and most spectacular animal of the Indian jungles is the tiger, the most noble in appearance the elephant; but the concensus of opinion is that the Indian wild boar is the bravest and most gallant of all.' . . . 'Nothing for size and ferocity could surpass, if it could equal, the pure Bengali breed; other hunters, however, declare the Deccany pig to be unrivalled for speed and ferocity.'; while a widely experienced expert has declared, 'Give me a Bengali hog in Guzerat country.' . . . 'No man who has not been an eye-witness of the desperate courage of the wild hog would believe in his utter recklessness of life, or in the fierceness that will make him run up the hunter's spear, which has passed through his vitals, until he buries his tusk in the body of the horse, or, it may be, in the leg of the rider.' . . . 'The hunter loses his seat at the peril of his life.'

Praise of Pigsticking: Pigsticking is the grandest sport that India or any country affords. 'Some have condemned pigsticking as cruel, yet of all sports this is the only one practised in modern times where the hunter shares, on almost equal terms, the danger with the hunted. It has a code of honour; the boar is hunted with respect and pursued on certain fixed principles; and there is a *casus belli*, for he is an incorrigible plunderer.'

An enthusiast has composed the following imperishable verse:

'Youth's daring spirit, manhood's fire,
  Firm seat and eagle eye,
Do they require who dare aspire
  To see the wild boar die.'

Under the altered conditions in India pigsticking is now almost a dream of the past, and all the above of little more than academic interest.

There are two records in the Society's journal of a wolf being ridden down and speared, or shot, by a single horseman. Only in favourable country can the feat be accomplished, and the horse must have a good stride and be in really hard condition, for the distance covered may be 16 to 18 miles. A gorged wolf is easily dealt with. Here it may be remarked that there is no record of the Indian Wild Ass having ever been run down by a single horseman. The animal is able to attain, and keep up without difficulty, a speed of 30–32 miles per hour.

FALCONRY

Hawking is not now so much practised in Rajputana and Northern India as it was even sixty to eighty years ago. In 1908 an expert modern falconer wrote, 'A few days' roaming about a river bank with a net, a set of nooses and some mynahs and sparrows in a cage, and I had collected two peregrines—one a laggard and the other a splendid dark bird in her first year—a *saker*, a *luggar* and two merlins, and within a month was ready for houbara, herons, paddy-birds, crows, kites, hoopoes and larks, and surely it would be a bad day on which I could not find one or other of the above. The *saker* I kept exclusively for kites, the young peregrine was all there when she saw a heron, and both had been "entered" to houbara.'

The list of animals and birds which can be captured through falconry in India is a long one: antelope, gazelle, hares, cranes, egrets, herons, ibises, spoonbills, stone plovers, storks, houbara, florican, jungle-fowl, partridges, peafowl, sandgrouse, crows, kites, grass owls, vultures, hoopoes, larks, rollers, sparrows.

In the *Journal of the Bombay Natural History Society* 'The Review of the Accipitres' is of the greatest interest; and the article, 'Shakespeare on the Noble Art of Hawking' is of interest not only to lovers of Shakespeare.

FISHING

Bombay: The Bombay Presidency Angling Association was started in Bombay with its centre of activities at Powai Lake about 1932 by the late Mr. H. B. Hayes of the American Express Co. Inc., Mr. J. G. Ridland of the Imperial Bank of India and few others, the fishing rights being secured from the Bombay Municipality.

In the initial stages the only fish available were minnows (*Rasbora daniconius*) and olive carp (*Barbus sarana*), but several thousand fry of rohu and catla were released in the lake, and they have grown both in size and numbers. The club is now well established with a membership of over a hundred, and the lake teems with rohu and catla, the former scaling between 20 and 30 lb. while a 65 lb. catla was landed a few years ago. As usual, much heavier fish are said to have got away! More fry have again been recently released and the lake is well stocked for many years.

Madras: The Angler's Club initiated in Madras in 1946 was short-lived. It would seem that India is not yet ready for an Angling Association on Western lines. Perhaps the Angling Club now (1952) proposed to be formed in Mysore State may have more lasting success.

Books on angling in India are listed in my 'Bibliography of Big Game Hunting and Shooting in India and the East.' (*J.B.N.H.S.* 49; 222–241).

Trout of the East and the West

The so-called 'Indian Trout' of the rivers of Central India, Northern India, Assam and Burma is a worthy rival of the trout and grayling of Western countries. But the successful introduction of the trout of those lands in the upland streams and lakes of Ceylon, the Nilgiri and Travancore Hills, Kulu and Kashmir has brought great enjoyment to many anglers; and there is the landslide-formed Guhna Lake in Garhwal which has proved to be a natural spawning ground and is said to be one of the best trout fishing areas in this country. It is now only two marches from Chamoli where is the terminus of the bus route from Hardwar to Badrinath. Six marches from Tehri is the Dodhi Tal (lake) in Tehri Garhwal where the trout are large and five pounders common.

Regarding the introduction of trout into India pp. 601–3 of the article 'History of transplantation and introduction of Fishes in India', by S. Jones and K. K. Sarojini, published in Vol. 50 No. 3 (April 1952), may be seen.

In these days of the motor vehicle the angler in India has quicker access to localities than formerly; and through hydro-electric projects a number of lakes have been formed. On the other hand, these same projects, and certain canal weirs also, have adversely affected migration of important species to spawning grounds, thereby greatly altering some of the rivers and streams of the country to the detriment of the angler and the food supply of the people alike.

From articles in the *Journal*, and earlier angling books and records, it seems that on the whole the angler is not able at this time of writing to have equal success with mahseer in running waters as in former days. Assam has always been a grand province for the angler, but those formerly prolific waters will have been much altered by the recent earthquakes.

The issue in the *Journal* in serial form of the book by A. St. J. Macdonald, 'Circumventing the Mahseer and Other Sporting Fish in India and Burma', and its publication by the Society as a book in 1948 was a notable event.

The Society's journal contains close on 300 articles and Miscellaneous Notes on all aspects of fish and fishing both from the angle of sport and of commerce.

In 1907, following the publication in the *Journal* of certain papers (Vol. 17; 637–644) the Society moved the Government of Bombay in respect to legislation for protection of fisheries in Western India; and on 16th January 1908 (Vol. 18; 668–669) addressed the Government of Bombay asking that the expediency of creating a Fisheries Department be favourably considered. That led to useful results in many directions; but from a New Delhi press report of 10th May 1952 it is apparent that even after all these years a great deal remains to be done.

Of the 1,00,00,000 maunds of fish taken from the sea in each year only 32 per cent is consumed as fresh fish. This, says the report is due to unsatisfactory transport facilities, inadequate supply and distribution of ice and marketing facilities. Other defects are scattered fishing centres and primitive methods of catching, preserving, transporting and marketing. It is emphasized that with proper arrangements and scientific control the fishing industry can make a substantial addition to the country's food resources. So much as regards sea and maritime fishing.

Inland, the activities of the Fisheries Departments have been in recent years principally directed towards stocking of lakes and tanks. Running waters have not received adequate attention. Moreover, the malpractices declaimed by Day and Thomas over eighty years ago—wanton destruction of the nation's fishery resources through use of explosives, fish poisons, capture and waste of fish fry and spawners—have not at all abated, and are getting worse. India should emulate the example of the Philippines where a favourable public opinion in these matters has been brought about.

Defects in regard to running waters have been pointed out by several contributors—Hamid Khan (Vol. 43; 416–426) and (Vol. 46; 193–194); Setna and Kulkarni (Vol. 46; 126–132); and there is a valuable article in two parts by Jones (also in Vol. 46) with which is a long reference list. Fishing contrivances in the Hyderabad State are dealt with by Mahmood and Rahimullah (Vol. 46; 649–654); and there is a note by H. de B. Codrington pointing out how much has yet to be discovered in regard to the Mahseer, the premier sporting fish of India.

The illustrated article, also published in pamphlet form, by Spence and Prater on the 'Game Fishes of Bombay and the Deccan' is valuable to anglers. Indeed, the Society through its *Journal* has done much to aid and inform regarding the land and sea fish and fisheries of the sub-continent.

* * * *

Evolution of the Sporting Rifle

The early days of European sportsmen in India were those of the flintlock, powder horn and bullet pouch. Then came the percussion cap followed by the breech-loader. The accuracy of those 18-bore muzzle-loaders was obtained by a sharp twist of rifling necessitating the small charge of 1¼ drs. of powder which gave a high trajectory to the spherical bullet of hardened lead, and insufficient shock to the animal. To remedy this, bullets containing an explosive charge were also used by Rice and his companions in Rajputana during 1850–1854 when sixty-eight tigers were killed, some of them having to endure up to a dozen bullets, and another thirty wounded but not recovered.

The Express System: About 1840 Sir Samuel Baker introduced the large bore rifle with a heavy charge of powder; and in the 1860's arrived the 'Express' system devised by Forsyth. In the beginning, the hollow-pointed conical bullets had insufficient base. This caused much wounding of animals and, even as late as 1895, a number of tiger and panther maulings and fatalities. When the bullet was improved and used by discriminating sportsmen the black powder Express was an efficient weapon against soft-skinned animals. Even now, some tiger-slaying sportsmen are partial to the ·577 D.B. black powder Express taking 75 grains Nitro powder and a 650 grains conical bullet. The Forsyth system of the 12 bore rifle with slow spiral rifling was in vogue until the late 1890's, the bullet being either spherical or blunt conical. Some designs of the latter contained an explosive charge detonated by impact in the animal. Meade's spherical explosive bullet was used in shotguns.

H.V. Smokeless Powder Rifles: With the advent of smokeless powder, black powder weapons were superseded and there arrived 'the battle of the bores' 'which sportsmen of experience resolved into a small bore (under ·400) magazine rifle with the 'Nobeloy'-jacketed solid soft nose bullet of weight not less than 180 grains for hill shooting; and, as a constant companion in plains forests the ·375 Magnum magazine which, for an initial shot, is equal to any animal met with. The weapon ordinarily used for dangerous game, or following up wounded animals is the D.B. H.V. rifle of the ·470 class.

Space does not permit of detailed mention of the 'Paradox' and other systems as big game weapons, or the various types of expanding shotgun bullets; or the miniature rifles such as ·295, ·300, and ·310 advisable for antelope and gazelle shikar in populated open spaces.

Big Game Photography in India

Wild Life Photography is a modern sport of a high order, perhaps more especially in the wide, open spaces of the hills and plains. The man with a rifle has his difficulties; but the sportsman-photographer who has to take his 'shot' at a much closer range and bear in mind half a hundred things of importance before he can press the camera trigger has to be a stalker almost in a class apart.

The first book on big game photography in India—'With a Camera in Tiger Land'—was published by Champion in 1927. This pioneer work attracted much attention and was followed three years later by 'The Jungle in Sunlight and Shadow,' by the same author. Many of the photographs in these books were taken at night by automatic flashlight apparatus; so also most of the 120 photographs in the two sumptuous volumes by Bengt Berg. The article on 'Measurement and Photography of Big Game' by Stockley is good guidance to the shikari-photographer and the sportsman.

Success with his camera in the forests of Burma is illustrated in the two articles by Peacock; and the late Theodore Hubback enriched the *Journal* with five photographs and thirteen pages of valuable information as to the habits and hunting of the Malayan Gaur, or Seladang. This was followed by his article 'Wild Life Photography in the Malayan Jungles' portraying elephant, seladang and sambar at salt-licks together with eleven pages of great value and interest—Apparatus, Hides, Taking the Photographs, Outfit, The Menace of Damp, Animal Psychology. In another article the vanishing Two-horned Asiatic Rhinoceros (*Dicerorhinus sumatrensis*) is fully written up and pictured by Hubback, with additional notes by Prater, the whole forming a monograph on the species.

The finest-ever photograph of a wild bull elephant taken in the Thayetmyo Yomah of Burma by W. S. Thom at a few yards distance with a 17½ inch Ross Telecentric Lens, and the thirteen pages of this most interesting contribution are a delight to shikaris.

At the present time the Society has valued contributions from the camera and pen of E. P. Gee of Assam.

WILD LIFE PRESERVATION

About the middle of the eighteenth century the animals of the open country were still in much the same numbers as they had always been, but following the advent of sporting firearms in increasing number, and the pressure on the land through a growing population, the stock of antelope and gazelle all over the country has been greatly reduced—almost to vanishing point in some places. In areas of Upper India where antelope of both species still have a measure of protection on religious grounds they are still in fair number; but outside those special localities they are becoming more and more scarce.

Through the length and breadth of India it is no longer possible for the traveller to view these lovely creatures from railway or motor car window. In that respect there is a lifeless landscape; nor does the former common sight of a stately bustard now delight the eye.

Everywhere the Great One-horned Rhinoceros is now protected. The wonder is that it has survived its relentless pursuit by poachers and the indiscriminate shooting of it by sportsmen in earlier days. The Wild Buffalo should be under strict protection. The tracking and shooting of a solitary bull has afforded genuine sport.

The Indian Gaur, or 'Bison' seems at present to be holding its own; but too many are shot, some are being poached for meat, and the species is subject to cattle diseases—so there is no room for complacency.

None of these animals should be shot except on foot, and not by driving. If that is not possible they should be left alone, for what sport is there in slaying them from an elephant or in a beat?

It is much to be feared that the Brown Bear of Kashmir and adjacent hill territories is approaching extermination because of its handsome pelt. A male has been measured to be 7½ ft, with girth of 58½ inches. Weight about 500 lb. The Himalayan Black Bear was formerly in great number in Kashmir and Poonch, but much toll of the species has been taken by sportsmen, and also in organized drives on the ground that the animals are not only destructive to crops but often maul and kill the villagers.

Owing to its widely extended forest and mountain habitat, the species is not yet in danger of extermination. Notwithstanding all the poaching and malpractices, there is still, in some places and due to local circumstances, a fair but decreasing number of sambar, chital, swamp deer, hog deer, and barking deer. Because of its commercially valuable scented pod the Musk Deer is being everywhere slain.

In Burma the Brow-antlered Deer survives only in zoological gardens, while the Manipur race is extinct.

Survival of the elephant where it exists in a wild state is due to the Elephant Preservation Act, 1873, since when proscribed males only may be killed. Recently, in the Madras State, interested parties have obtained the retrograde step of an alteration in the law to permit of females also being proscribed in the cause of cultivation.

In earlier days wolves were a real menace to the people in many parts of India. Williamson (1780–1806) relates how the troops used to assist in smoking them out of dens, and shooting, trapping and killing them by various methods. The wolf, being a creature of the open country, has been greatly reduced through extension of cultivation; yet, in a few areas, the animal still gives sporadic trouble.

Kashmir in 1924. Of preservation of game in Kashmir, Ward rightly remarked : ' When we consider the difficulties experienced in preserving game in Great Britain we can imagine what has to be faced in the case of tens of thousands of square miles of rugged and mountainous country. It is useless to imagine that poaching in Kashmir can be stopped.' Since then the situation has greatly worsened. Ward's series on Kashmir and the Adjacent Hill Provinces is a complete *vade mecum* for the sportsman-naturalist.

Kashmir and India in recent years: Of the Kashmir Stag it was reported in February 1951 that since the 1947 troubles began there has been rapid disappearance of the species from localities where it was formerly abundant. The 1950 Pakistan report to the I.U.P.N. was that fauna is being rapidly diminished, and that military occupation of certain Himalayan regions has not bettered the situation ; while the report from India said that the situation is gloomy and poaching extensive. The India report referred to the whole country and not to Kashmir in particular.

The Role of the Society: The influence of the Society towards Preservation of Game commenced in 1888, and has continued all through the subsequent years, as can be known through perusal of the many references published at pp. 620-22 of Vol. 47, and other contributions in later volumes.

The Society's Honorary Secretaries—Phipson, Millard, Spence, Sálim Ali, Humayun Abdulali and others—and the Curator, S. H. Prater have been ever mindful of the influence which can be exercised, and the Editors have given valuable aid through means of a number of important editorials. Had the experienced and expert advice contained in all the above—and in the special illustrated series in five parts compiled by Prater (Vols. 36-8)—been heeded by the various governments, administrations and departments the rapidly deteriorating state of affairs at present existing would not perhaps have come about. But there are many factors and facets in this matter.

In his address to the Society on the 17th March 1930 the President (H. E. Sir Frederick Sykes, Governor of Bombay), remarked that in this country we are confronted with the almost insurmountable difficulty of persuading the masses to have any regard for the principles of wild life preservation; but there is now much more to it than that. Example is more than ever necessary; for a very great difficulty at the present time in India is the increasing number of officials with no interest in sport or natural history, and the rapidly lowering shikar ethics. Even among those who should know better, proper sporting considerations are subordinated to the hunger for meat and the 'something-for-nothing' attitude of mind of the man with the gun.

Want of Public Opinion: At the All-India Wild Life Conference held at Delhi in January 1935 it was declared that Indian Wild Life could only be saved by Public Opinion, and that legislation, however efficient, could do little in matters like these without the whole-hearted support of the Public. There is as yet no sign of a proper public opinion while there *has* been apathy, and even discouragement on the part of the authorities. 'Forests, while saving us from the ravages of flood and famine, can themselves become a menace to cultivation'; and there have been other utterances which are almost direct incitements to users of guns to turn them against wild life. As the present writer has said in letters to the newspapers, 'deer and other wild creatures are just lumps of meat and catchers of votes.'

Laws are enacted, rules are made and forgotten, for there is no continuity of official enforcement and no public opinion to keep them in mind.

India's Vanishing Asset: A comprehensive pamphlet stressing the urgent need for immediate steps towards conservation was printed in January 1948 and widely circulated, with covering letters from the Society and the author (R. W. Burton) to the Governors-General of India and Pakistan, to Prime Ministers and many other high officials; and a précis was circulated through the newspapers and press services all over the country. The pamphlet was printed in the Society's *Journal* (Vol, 47; 602–22) together with a list of 56 references. The Society's notice about it is at p. 792, Vol. 47. 500 copies of a Special Appeal relating to Reserved Forests was also distributed among divisional and other forest officers throughout the country. Later, a Supplement to the pamphlet by the same author (Vol. 48; 290–299) was cyclostyled and similarly circulated.

At no time did it seem that the above impassioned appeals had attracted any attention except for the one Miscellaneous Note [Vol. 48 588. (1949)] by M. D. Chaturvedi. But there is reason to suppose that sundry measures such as The Bombay National Parks Act, 1950; The Bombay Wild Birds and Wild Animals Protection Act, 1951; the Committee assembled at Delhi on 23rd and 24th July 1951; and now the Central Board for Wild Life appointed by the Government of India to preserve the Fauna of India (Press Note; New Delhi, 11th April 1952) have stemmed from the original pamphlet and other writings. The Hailey National Park and the United Provinces National Parks Act, 1935, resulted from the activities previous to the 1935 Delhi Conference.

A Central Board for Wild Life: This Board was constituted at Delhi on the 4th April 1952 by a Ministry of Food and Agriculture Resolution. It will function through States' Wild Life Committees and will meet at least once in two years.

If this Central Board and the States' Committees have before them in correctly summarized form the principal contents of all the main wild life contributions to the *Journal*; the 16th October 1950 thirteen page Memorandum by the writer; and the Address delivered by M. S. Randhawa to the Section of Botany, 35th Indian Science Congress, Allahabad, 1949. ('Nature Conservation, National Parks and Bio-aesthetic Planning in India'), and study and apply all that is practicable in them there should be good results: *but* the States' Wild Life Committees need to be formed quickly and all that is decided speedily put in motion or results will be of little avail, also too little and too late as has proved to be the case with previous Conferences and Committees.

A Department for Wild Life: It has to be conceded that no such Department will be formed in India—not yet awhile at any rate—but it was counselled by the Society [Vol. 38; 223. (1934)] that there is need for creating a definite agency within the forest department for administering the laws relative to the protection of wild animals. This is supported in the above-quoted note by Shri M. D. Chaturvedi, the present Inspector-General of Forests and a Vice Chairman of the new Central Board. A weighty consideration is that the success or failure of game preservation depends upon a wholly trustworthy and impeccable subordinate staff.

National and States Forest Policies: The recently announced Forest Policy for India should have excellent long-range effect on wild life in general; and the C.P. (1st May 1952) Plan announcing 46 recommendations (including game reserves) for management and future development of the Madhya Pradesh protected forests, tree forests, minor forests, pasture lands, recreation forests, fuel and fodder reserves should be a valuable guide to other States and Unions.

South India and the Nilgiris: At the Meeting assembled at Ootacamund on the 7th June 1933 by the Governor of Madras it was decided to form an Association for the Preservation of Wild Life in South India. The project was launched, but within a year proved completely abortive and was never heard of again.

The only bright spot has been the mostly effective preservation of game in the Nilgiris District [41: 384–96 (1939)].

Ceylon: In December 1949 Ceylon attained the long sought for Wild Life Department, and the growth of it during 1950 gave hope that at last the menace of the professional poacher and the commercialisation of wild life would be halted.

Uttar Pradesh and Assam: The sub-montane tracts of the former United Provinces have always been well stocked with game animals and birds. With some exceptions this obtains at the present time. Let us hope that no Caliph will arise to alter all this.

In Assam there is now a strong movement associated with the names of P. D. Stracey and E. P. Gee. A thousand pities it began too late to save the Manipur race of the *thamin* from extermination, for there was sufficient warning of what was happening.

Burma and Malaya: In spite of vigorous efforts and warnings by Smith, Peacock, Weatherbe, and Hubback important species have vanished or are nearing extermination in these countries—

and this before the two countries were overrun by the Japanese during the last war.

Education in Schools: 'The youth of today must become the conservationists of tomorrow.' The Bombay Natural History Society has worked towards this end with, as yet, no widely extended results, and the present writer has been urging the need for the past five years. Sir Frederick Sykes (1930) said that we should aim at teaching the children to appreciate the value of wild life. In his address to the Ceylon Game and Fauna Protection Society on 14th December 1950 the Governor-General and Patron of that Society said, among other things, 'There is need for extensive propaganda and education, and the Government and this Society can co-operate to convince the younger generation in the schools that they will, and must be, the future custodians of wild life'—to which can be added 'and of the forests also.'

At the present time the International Union for the Protection of Nature is making considerable effort in this direction, and Italy, Greece, French Cameroon, Mexico, Belgium, Belgian Congo, Madagascar, and Turkey are issuing special lessons on the subject for the interest of educators and use by teachers and pupils in primary and secondary schools.

'In spite of its importance to mankind, the theme of these lessons is little known or totally ignored by contemporary nations.' How very true it is that,' Many are the paths along which man proceeds to (his own) destruction . . . '.

The Education Departments of Governments in India have a great responsibility in regard to education of the children in matters affecting wild life and world resources.

CONCLUSION

In the 1948 Pamphlet the writer remarked (Vol. 47 ; 618) :

'An atmosphere of mistrust and suspicion is all too common among uneducated people, so the beneficial intentions of measures towards wild life preservation are apt to be misconstrued unless the objects and reasons receive the widest publicity through Government channels—and the newspapers.

The years are passing ; this great national asset is wasting away. It is the duty of every government to preserve it for posterity. The urge should come from the highest levels.'

Opportunity is taken to again plead for the above, and for the essential whole-hearted aid by editors and journalists.

APPENDIX

A LIST OF THE GAME ANIMALS OF INDIA, BURMA AND CEYLON

NOTE.—(H). Hunza only ; (B), Burma only. (C), also in Ceylon.

The Indian Elephant—*Elephas maximus indicus* (C)
The Great Indian Rhinoceros—*Rhinoceros unicornis*
The Smaller One-horned or Javan Rhinoceros—*Rhinoceros sondaicus.*

The Sumatran Two-horned Rhinoceros—*Rhinoceros sumatrensis*
The Malay Tapir—*Tapirus indicus*

Sheep

The Great Pamir, or Marcopolo's Sheep—*Ovis ammon poli*
The Great Tibetan Sheep, or Nyan—*Ovis ammon hodgsoni*
The Shapu of Ladak—*Ovis vignei vignei*
The Urial of Punjab—*Ovis vignei punjabiensis*
The Bharal—*Pseudois nahoor*

Goats

The Asiatic Ibex—*Capra sibirica*
The Sind Wild Goat—*Capra hircus blythii*
The Markhor—*Capra falconeri falconeri*
The Pir Panjal Markhor—*Capra falconeri cashmiriensis*
The Suleiman Markhor—*Capra falconeri jerdoni*
The Himalayan Tahr—*Hemitragus jemlahicus*
The Nilgiri Tahr—*Hemitragus hylocrius*
The Serow—*Capricornis sumatraensis*
The Grey Himalayan Goral—*Nemorhaedus goral*
The Brown Goral—*Nemorhaedus hodgsoni*
The Burmese Goral—*Nemorhaedus griseus* (B)
The Mishmi Takin—*Budorcas taxicolor*
The Indian Wild Ass—*Equus onager indicus*

Antelope and Gazelle

The Indian Gazelle—*Gazella bennetti*
The Persian Gazelle—*Gazella subgutturosa typica*
The Indian Antelope or Blackbuck—*Antilope cervicapra*
The Nilgai or Blue Bull—*Boselaphus tragocamelus*
The Four-horned Antelope—*Tetraceros quadricornis*

Deer

The Kashmir Stag—*Cervus kashmiriensis*
The Sambar—*Rusa unicolor* (C)
The Spotted Deer, or Chital—*Axis axis* (C)
The Hog Deer—*Hyelaphus porcinus* (C)
The Swamp Deer—*Rucervus duvaucelli*
The Brow-antlered Deer of Manipur—*Panolia eldi eldi*
The Brow-antlered Deer of Burma—*Panolia eldi thamin* (B)
The Barking Deer, or Muntjac—*Muntiacus muntjac*
The Mouse Deer, or Indian Chevrotain—*Moschiola meminna* (C)
The Musk Deer—*Moschus moschiferus*

Bovinae

The Indian Wild Buffalo—*Bubalus bubalis* (C)
The Gaur, or 'Indian Bison'—*Bibos gaurus*
The Banteng or Tsaing—*Bibos banteng birmanicus* (B)

Bears

The Himalayan Brown Bear—*Ursus isabellinus*
The Himalayan Black Bear—*Ursus torquatus*
The Sloth Bear—*Melursus ursinus* (C)
The Malayan Bear—*Helarctos malayanus*

Beasts of Prey

The Asiatic Lion—*Panthera leo persica*
The Panther—*Panthera pardus* (C)
The Tiger—*Panthera tigris*
The Snow Leopard, or Ounce—*Uncia uncia*
The Hunting Leopard, or Cheetah—*Acinonyx jubatus*
The Clouded Leopard—*Neofelis nebulosa*
The Caracal—*Felis caracal*
The Striped Hyena—*Hyena striata*
The Indian Wild Dog—*Cuon dukhunensis*

Tibetan Game Animals

The Yak—*Poephagus grunniens*
The Tibetan Antelope—*Panthalops hodgsoni*
The Tibetan Gazelle—*Gazella picticaudata*
The Tibetan Wild Ass—*Equus kiang*

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NOTES ON THE GENUS *SALICORNIA* LINN. (CHENOPODIACEAE)

BY

CHARLES McCANN, F.L.S.

(*With two plates*)

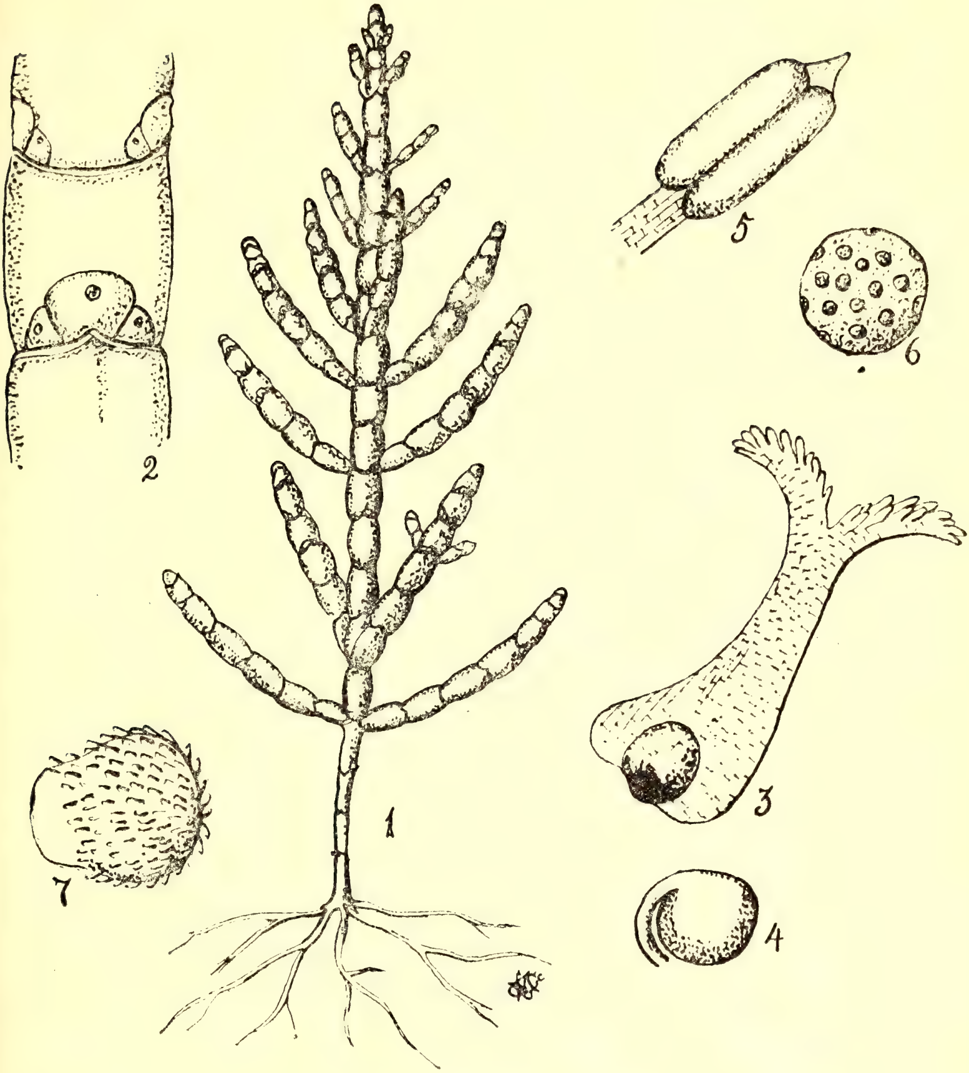
Some years ago, when studying coastal vegetation in the field, I experienced some difficulties regarding the floral construction of *Salicornia*. My observations did not agree entirely with the descriptions in authoritative works. My main difficulty was the correct number of stamens. The species under observation, at that time, was the Asiatic *Salicornia brachiata* Roxb. Since then, I have had the opportunity of extending my studies to the New Zealand *S. australis* Solander. Here again, I was confronted with the same difficulties. Under the circumstances, I feel that I am now in a position to discuss the point more confidently, and, at the same time, to draw a comparison between the two species and record other field and morphological characters.

The floral structures of *Salicornia* are so minute and difficult to dissect that it is no wonder their true construction has not been correctly recorded. Added to this is the hitherto unnoticed manner in which the stamens are extruded.

Most of the genera of the family Chenopodiaceae are described as having 3 to 5 stamens. *Salicornia* 'appears' to be the exception. It is described as having *one* or *one to two* stamens. After my experience in the field I did not feel very happy about these statements and so determined to investigate the matter further. After an examination of a very large number of flowers at different stages of development, I found in some instances what appeared to be the dried filaments protruding through the 'floral pore'. The number of such filaments varied from *one to four*, in addition to the remains of the bifid style. This number seemed to be more in keeping with the family characteristics. Not being quite satisfied with my results, I pursued the subject further and eventually found the fifth stamen in a very young floret (in *S. australis*).

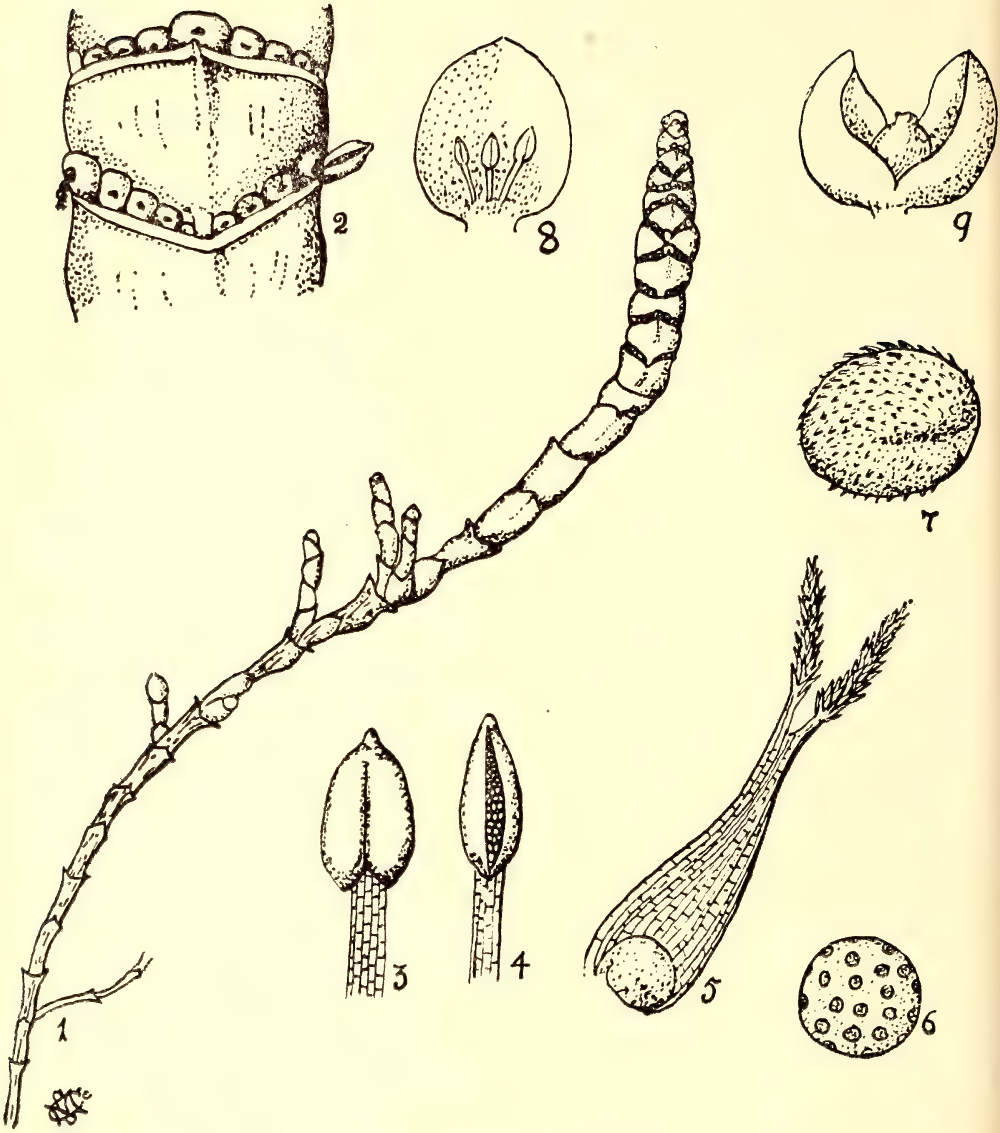
In the fresh flower, field observations indicated that *only one* stamen is extruded at a time through the floral pore, but that this one is succeeded by the others. This behaviour, no doubt, accounts for the oft-repeated statement, 'stamens one'. Besides the number of stamens, there are a few other details which need to be dealt with from a field point of view, and these will be referred to under their respective heads.

Habit: *Salicornia brachiata* is an erect annual, growing chiefly in a substratum of a mixture of mud and sand. *S. australis* is a perennial growing in rocky situations amongst shingle—or at least with an underlying substratum of such material—where it is deeply anchored. The former (*brachiata*) develops after the monsoon rains,



Salicornia brachiata Roxb.

1. Entire plant ; 2. flowering nodes ; 3. pistil ; 4. embryo ; 5. anther ; 6. pollen grain ; 7. seed.



Salicornia australis Soland.

1. Portion of plant ; 2. flowering nodes ; 3 and 4. anthers ; 5. pistil ; 6. pollen grain ; 7. seed ; 8. floral lobe with 3 stamens ; 9. floral lobes round ovary.

and continues to flourish throughout the dry season, maturing its seed before the advent of the following monsoon. The old stems remain standing till they are beaten down by wind and waves, or succumb to decay. The latter (*australis*) flourishes throughout the year, but the old succulent tissue dries up leaving a wiry, yet living stem, surmounted by fleshy tissue towards its extremity—the vegetative growth of the last season. The period of greatest vegetative activity (in *australis*) is during the spring of each year, followed by the new inflorescences. At the extremity of each succulent 'finger' the topmost segments are confined to the production of flowers and fruit—'inflorescences terminal'. During the winter months growth is considerably retarded. Incidentally, most rain in New Zealand falls during the winter period.

We have already observed that *S. brachiata* is killed off with the advent of each monsoon season, a period when the rains neutralise the salinity of the inshore waters. Perhaps this factor inhibits the growth of new plants. It is of interest to note that, in the case of *S. australis*, growth is also retarded at a time when there is an increase in the rainfall, apart from the factor of low temperature at the same period. However, I am fully aware that no one factor, alone, is responsible for the reduction of vegetative growth, but that several factors come into operation in unison.

Stem: An interesting question about *Salicornia* is, What actually constitutes the stem and branches? Outwardly, the stem and branches appear as succulent structures, but a cross-section reveals a hard wiry core surrounded by succulent tissue. This question appears to be partly answered by the perennial species, *S. australis*. In that species the fleshy tissue dries up on the older portions leaving a wiry, *yet living*, structure capable of producing one or two new succulent shoots at each node. Another point worthy of note in *S. australis* is that the fructifying region disintegrates after maturation, leaving a truncated section. This extremity is capable of producing two new shoots, suggesting dichotomous branching. If we restrict the term stem to the wiry core within the succulent tissue, we are then faced with the problem, What is the origin of the succulent tissue and how are we to designate it? Is it to be regarded as part of the foliar structure? With these questions I must pass on to the leaves themselves.

Leaves: At one time the *Salicornia* were described as leafless. However, the subject has given rise to much discussion, and the opinions have been varied. Duval-Jouve (1868) regarded the succulent outer tissue of stem and branches as of foliar origin. Babington (1904), Bentham (1858) and Hooker (1884) considered the *Salicornia* to be leafless, and that the succulent tissue represented stem cortex. De Bary (1884) expressed the view that the free extremities of the fleshy internodes constituted the scale-like leaves arranged in a decussate pattern. De Fraine (1913), after a careful study of the anatomy of the genus *Salicornia*, agrees with Duval-Jouve in treating the succulent tissue as foliar in origin. After careful observation in the field of both *S. brachiata* and *S. australis* I arrived at an independent, but similar conclusion (I was not aware of the papers quoted above at the time of my own studies). My conclusions were based largely on the comparison of the two species in the field, and rough transverse sections.

De Fraine (1913) has proved beyond doubt that the succulent tissue surrounding the internodes is foliar and that it is formed by the congenital fusion of two opposing leaf-sheaths. The leaf tips constitute the membranous collar at each node. De Fraine (1913) speaks of periodic shedding of the succulent tissue (after desiccation) in the perennial species, and that the annual species shed their foliar structures towards the close of the flowering period. As far as my observations go, I must confess that I have not observed leaf-fall in either *S. brachiata* or in *S. australis.* On maturity the succulent tissue dries, but remains adherent to the stem until it is rotted off by repeated wetting or removed by friction.

Flowers: The number of florets in each leaf-axil is variable but there seems to be some uniformity within the species; this may form an useful accessory taxonomic character. In *S. brachiata* the number in each axil varies from 1 to 3, but 3 appears to be the more frequent number; in *S. australis* the number varies from 5 to 10, but an odd number is more frequent.

Each floret is somewhat urceolate or obpyramidal, depending much on its position in the axil; 3 to 5 minute teeth or lobes border the floral opening (very suggestive of calyx teeth); its walls are much thickened. Within the 'calyx cup' I discovered two minute orbicular, deeply concaved, membranous floral lobes, pl. 2, figs. 8 & 9 (perhaps corresponding to a corolla) embracing the ovary. Within these lobes I was more than surprised to find the young stamens, two in one lobe and three in the other. Thus in the case of *S. brachiata* I found four stamens and five in *S. australis.* This was final confirmation that the normal number of stamens in *Salicornia* is 4-5. (It is extremely difficult to tease out these minute parts.)

The *stigma* is bifid, the arms minutely papillate. Usually, the stigma is extruded after the first stamen.

Authoritative works define the number of *stamens* in *Salicornia* as 1, or 1 to 2. The usual number for the family Chenopodiaceae is 5. Why did *Salicornia* alone appear to deviate from the usual family character of 5 stamens? The question puzzled me and aroused my curiosity. I determined to find the solution. After an examination of very many florets in the fresh state, I discovered in some the remains of the filaments of more than one stamen, in addition to the remains of the style. Further dissection finally revealed that there were actually five. The next thing was to observe the anthers themselves. On examining immature florets it was found that only one anther matures at a time. This occupies all available space till it emerges through the 'floral pore'. The extrusion of the first anther is followed by the style, the remaining anthers appearing later. This mode of succession evidently has something to do with pollination.

The pollen in both species is very similar; it is spherical and pitted. Apparently, the pits are responsible for the somewhat adherent quality of the pollen, for, although some of the pollen may be wind borne, much of it remains adhering to the surface of the plant and tends to 'roll' along it. Few insects visit the flowers, but I have observed a minute thrips moving over the tissue. There is a possibility that these insects may play a part in pollination (?). However, it appears to me that both cross- and self-pollination is provided for. Cross-pollination by the movement of pollen from a freshly opened flower, with the anther dehisced, to a flower below, in which a freshly expanded stigma is mature; self-pollination by the stigma contacting the second anther from the same flower.

Seeds: In both species the seeds are very similar: they are compressed and provided with minute hooks.

Economics: In India, *S. brachiata* is frequently eaten as a pot herb by some of the poorer classes. It is boiled in much the same way as spinach. Accordingly, it is occasionally seen, on sale, in some of the local vegetable shops. I can find no reference to *S. australis* being used as a food in New Zealand.

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MOSQUITO WORK IN INDIA

BY

SIR GORDON COVELL, M.D., D.P.H.,

(Formerly Director, Malaria Institute of India)

For a proper appreciation of the development of mosquito work in India, it is useful to review the events which led up to the discovery of the mosquito transmission of malaria by Ronald Ross, then a Major in the Indian Medical Service, in 1897. Sir Patrick Manson, having shown by his researches in China that the development of the filarial embryo takes place in the mosquito, had become convinced that this insect also played an essential part in the transmission of malaria. He imparted this conviction to Ross, and thus inspired the brilliant series of investigations which culminated in the discovery of malarial oocysts on the stomach wall of an Anopheles mosquito at Secunderabad on August 20, 1897. Ross's knowledge of mosquitoes at that time was extremely limited, and he was unaware of the identity of the species dissected, but it was almost certainly that subsequently named by Liston *Anopheles stephensi.* In the following year, in Calcutta, Ross turned his attention to bird malaria and succeeded in following out the complete life cycle of the parasite, the mosquito used being presumably *Culex fatigans.*

How little was known of the mosquitoes of India at this time is well illustrated in the following passage from a paper by Colonel G. M. Giles, I.M.S., read before the Bombay Natural History Society in 1900: 'Two years ago, when I took up the task of collecting the history of the Culicidae[1], it is an actual fact that no more than four species were recorded as having been found in all India. There was in fact hardly any known country with such scanty records of the subject. The subjoined list includes 32 species, and I have little doubt that the final total of species will be found to be not far off a hundred, as new species are constantly turning up.'

By 1934, when P. J. Barraud published his volume on the Culicidae in the Fauna of British India series, the number of species in the sub-family Culicinae, including 43 Anophelini, had reached a total of 288, excluding named varieties.

Of the 43 species of Anopheles, only 7 are of major importance as malaria carriers in India: *A. culicifacies*, noted for its association with widespread regional epidemics of great severity, *A. stephensi*, the only vector capable of adapting itself to built-up city conditions, *A. superpictus*, the chief carrier in Baluchistan, *A. fluviatilis* and *A. minimus*, the notorious foothill vectors of southern and eastern India respectively, *A. philippinensis*, the chief vector of deltaic Bengal and *A. sundaicus*, the brackish water breeder of the Bengal and Orissa coastal areas.

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[1] Giles's *Handbook of the Gnats or Mosquitoes* was first published in 1900.

One of the most distinguished of the early workers on mosquitoes in India was S. P. James, who joined the Indian Medical Service in 1896. In 1898 he was posted to Quilon, in Travancore State, where his attention was directed to the study of mosquitoes chiefly on account of his interest in filariasis, which is extremely common in that part of India. Following up the researches of Manson, James succeeded in demonstrating filarial embryos in the head and proboscis of *Culex sitiens*, *Aedes albopictus* and *Anopheles subpictus*, and arrived at the conclusion that filariasis was transmitted by mosquito bite. These observations were made entirely independently of those of G. C. Low, whose paper recording his findings was, however, published a few weeks earlier than that of James.

In 1901, James was placed on special duty with the Malaria Commission of the Royal Society, two of whose members, J. W. W. Stephens and S. R. Christophers, had recently arrived in India after working for two years in Central and West Africa. Investigations were conducted in the neighbourhood of Calcutta, in the course of which for the first time the selective breeding habits of mosquitoes were recognised—the foundation of what is now known as *species sanitation*. Later in the same year the Commission moved to Lahore, where they initiated an experimental trial of malaria control by the obliteration or treatment of mosquito breeding places in the cantonment of Mian Mir. The result of this experiment, which extended over 3 years, showed that the control of malaria by antilarval operations was by no means as easy and simple as had originally been supposed, and that above all it required thoroughly organised action and constant strict supervision. In January 1902 the members of the Commission attended a Malaria Conference at Nagpur, and it was here that James formed the association with W. G. Liston, I.M.S., which bore fruit two years later in the first edition of their classic memoir on 'The Anopheline Mosquitoes of India'. Other names associated with these early investigations are those of Cogill, Aitken and Patton, all of whom contributed articles on mosquitoes in this *Journal*.

In 1908 Christophers (now an officer of the I.M.S.) and C. A. Bentley conducted an inquiry into the problems of malaria and blackwater fever in the planting districts of north-east India, particularly the Bengal Duars. In the same year there occurred a devastating regional malaria epidemic in north-west India, in the course of which more than 300,000 persons died in the Punjab alone. In one sense this proved a blessing in disguise, for it led to the calling of an Imperial Malaria Conference at Simla in the following year which recommended the formation of an organisation for the study and prevention of malaria in India, comprising a Central Scientific Committee and a Local Malaria Committee for each province. There was appointed in each province an officer trained in malaria research, to carry out investigations which would form the basis of preventive measures, and the study of mosquitoes throughout the Indian sub-continent was greatly extended. In the years 1909-10 Bentley made a detailed survey of malarial conditions in Bombay City and in 1911 Christophers conducted an inquiry into the causes of malaria in the Andaman Islands. Similar surveys of malarious tracts were undertaken in other parts of India by Fry, Graham, Kendrick, Adie, Perry, Gill, T. S. Ross, Horne, Hodgson and others. The Central Malaria Bureau, under the direction of Christophers, was founded at Kasauli, where were started the collections which have formed the basis of most of the systematic work since carried out on the mosquitoes of India.

The first world war had a disastrous effect on mosquito work in India, but after the cessation of hostilities interest in the subject began to revive. Christophers, who had served during the war in Mesopotamia, returned to the Central Malaria Bureau and resumed his intensive study of Anopheles, and Barraud took up the study of culicine mosquitoes on similar lines. In 1927 a permanent malaria organisation, the Malaria Survey of India, now known as the Malaria Institute of India, was established. Its headquarters was originally at Kasauli, but was transferred to Delhi in 1938. Much detailed study of the mosquitoes of India from both systematic and biological aspects has been carried out by the staff of the institute both in its central laboratories and through special research units operating in various parts of the country. Among the more important works on mosquitoes published between the first and second world wars were Christophers's 'Provisional List and Reference Catalogue of the Anophelini' and the same author's volume on the Anophelini in the Fauna of British India series, Barraud's volume on the Megarhinini and Culicini in the same series, Covell's 'Distribution of Anopheline Mosquitoes in India' and 'A critical review of the data recorded regarding the transmission of malaria by the different species of Anopheles' and Puri's 'Larvae of Anopheline Mosquitoes, with full description of the Indian Species'.

The Rockefeller Foundation has also made a notable contribution to the study of Indian mosquitoes. From 1927 to 1933 W. C. Sweet conducted a series of epidemiological investigations in Mysore State, which formed the basis of the antimalarial campaign which has been in progress there in recent years. Dr. P. F. Russell carried out similar work in south-eastern Madras from 1936 to 1942, with particular reference to the problems of irrigation malaria. In both these investigations many important mosquito studies were included, particularly in regard to bionomics.

The Ross Institute of Tropical Hygiene established a branch in India in 1930, with centres in Assam and the Bengal Duars, and later in southern India also. The prevention of malaria has been a major feature of its activities, and this has involved an intensive study of mosquitoes and their habits. Much attention has been directed to the biological control of mosquito breeding by the growing of dense shade over water channels and by the flushing of streams by means of automatic sluices. Important researches on mosquito behaviour in Assam were also undertaken by R. C. Muirhead-Thomson under the auspices of the Royal Society and the London School of Hygiene and Tropical Medicine from 1938 to 1941.

In Bengal notable contributions to our knowledge of mosquitoes have been made by M. O. T. Iyengar, for many years Entomologist to the Bengal Health Department, and by C. Strickland and other workers at the Calcutta School of Tropical Medicine. Mention must also be made of the work of R. A. Senior White, who was for 20 years

Malariologist to the Bengal Nagpur Railway. During this period he carried out a series of intensive studies of the mosquito fauna of Bengal and Orissa and published a number of articles on the subject in various scientific journals.

The Development of Antimosquito Measures

Reference has already been made to the disappointing results of the first attempts in India to control malaria by antilarval measures. It became obvious that such methods were far too costly for application in rural areas, in which 90 per cent of the population of India is located. They were economically practicable only in circumstances where large numbers of persons were congregated in limited areas and where considerable financial interests were involved. During the next 35 years there were many examples where malaria was successfully controlled by antilarval measures in urban areas such as Bombay, Bangalore, Lucknow and Delhi, and among labour forces employed on tea, coffee and rubber estates or other industrial concerns. But in the villages of India the only procedure attempted was the provision of treatment for the sick—a palliative rather than a control measure.

In 1936, however, the publication of results achieved in South Africa by the spray-killing of adult mosquitoes in human dwellings with pyrethrum insecticide at a moderate cost encouraged the hope that here at last was a weapon which might prove practicable for use in rural India. Just at this time a comprehensive scheme of malaria control was being planned for the Delhi urban area, which covers approximately 60 square miles. The quarters occupied by government employees in particularly malarious sections of the area were sprayed throughout the malaria season with remarkably good results. In one set of quarters the malaria rate was reduced to 1.4 per cent, whilst a figure of 45 per cent was recorded in adjacent quarters which were left unsprayed during the same period. The method was thereupon recommended for use throughout India for personnel such as police, railway, forest or other government employees and labour forces in estates, mills and other industrial enterprises when housed in permanent quarters. It was at first thought that its usefulness would be limited to such conditions, but in 1937 it was applied with success in several villages in Delhi Province. Further experimental work on similar lines was carried out by the Rockefeller Foundation Malaria Unit in southern India from 1938 to 1941, and about the same time the measure was adopted on a large scale in rural areas of Mysore State.

During the early stages of the second world war, antilarval measures combined with the spray-killing of adult mosquitoes with pyrethrum insecticide proved inadequate for the conditions obtaining on the Burma front. With the introduction of DDT in 1944 a dramatic change occurred and in the two following malaria seasons the disease was reduced to such a low level that it was no longer of any military significance. Unfortunately, however, a system of rigid mass drug prophylaxis was put in force at the same time, and it is impossible to assess with any degree of accuracy the relative part played by each of the two measures. The destruction of adult mosquitoes with residual insecticides has however been the chief feature of all antimalarial campaigns carried out among civil populations during the post-war years, and in India, as elsewhere, the results achieved have been most striking.

Mosquito control measures in Delhi have now been extended throughout the rural area of the State. In Bombay State an organisation established in 1942 is now operating one of the largest and most successful DDT spray-killing campaigns in the world. Over 9 million persons are already under protection and it is expected that the number will reach 16 millions within the next two years. In Madras State there are 33 schemes in operation, protecting a population of 2 millions. In Mysore State 500,000 people are under protection. In West Bengal 97 antimalarial units are now operating and more than 3 millions are already protected. In Uttar Pradesh 7 schemes are in operation, protecting 2 million persons. In Coorg the destruction of mosquitoes with residual sprays has been extremely successful, with great benefit to the coffee planting industry. Four control schemes under the auspices of the World Health Organisation are operating in foothill tracts in Mysore State, Uttar Pradesh, Orissa and Madras for the past two years. Antimosquito measures are also in force throughout the coalfields of India and on most of the railways, and there are other schemes in operation in association with various engineering projects such as the Damodar Valley, Hirakud Dam and Tungabhadra. The most striking reduction in the malaria rate brought about by the application of residual sprays has been in the foothills of southern India where the chief vector is *Anopheles fluviatilis*, a house-haunting mosquito with a marked preference for human blood, and one of the most efficient malaria carriers in the world.

It is encouraging to note that the importance of antimosquito work is now fully recognised by the Government of India, and that plans are on foot to extend such operations until the entire population of areas where malaria is still rife are effectively protected from infection.

A list of publications relating to mosquitoes which have appeared from time to time in the *Journal* is given below.

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Aitken, E. H. (1901): Notes on *Anopheles* or malaria mosquito. **13**; 691.

Cogill, H. (1903): The Anopheles of Karwar (North Kanara). **15**; 327.

Patton, W. S. (1905): The Culicid fauna of the Aden Hinterland. **16**; 623.

Osborn, H. (1907): Destruction of mosquitoes and their larvae by fish and lime. **17**; 823.

Liston, W. G. (1908): The present epidemic in the Port of Bombay. **18**; 872.

Bentley, C. A. (1910): The natural history of Bombay malaria. **20**; 392.

Lloyd, R. E. (1910): Mosquitoes and fish. **20**; 1165.

Wright, R. E. (1918): The distance mosquitoes can fly. **25**; 511.

Covell, G. (1930): The malaria problem in Bombay. **34**; 735.

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[A full list of the species of mosquitoes hitherto recorded in India will be found in the two volumes on Culicidae by Christophers and Barraud in the Fauna of British India series, the former on Anophelinae, the latter on Megarhinini and Culicini.—Eds.]

FUNCTIONAL DIVERGENCE, STRUCTURAL CONVERGENCE AND PRE-ADAPTATION EXHIBITED BY THE FISHES OF THE CYPRINOID FAMILY PSILORHYNCHIDAE HORA

BY

SUNDER LAL HORA, D.SC., F.R.S.E., C.M.Z.S., M.I.Biol., F.Z.S.I., F.A.S., F.N.I.,

Director, Zoological Survey of India, Indian Museum, Calcutta

(*With two text figures*)

The family Psilorhynchidae, as defined at present, consists of a single genus *Psilorhynchus* McClelland which comprises three species, namely, *P. sucatio* (Ham.), *P. balitora* (Ham.) and *P. homaloptera* Hora & Mukerji. Hamilton's two species were originally described from the north-eastern parts of Bengal (Eastern Himalayas), and have since been very frequently collected from the small streams below the Darjeeling Himalayas. The range of *P. sucatio* has now been extended to the Gandak drainage by Menon (seen in MS.) and to the Damodar River basin by David (seen in MS.), while *P. balitora* has since been found in the Assam Hills (Hora 1921*a*), Upper Burma (Mukerji, 1933) and as far west along the Himalayas as Delhi (Majumdar, 1952), *P. homaloptera* is known so far only from the Naga Hills, Assam (Hora & Mukerji, 1935). It will thus be seen that Psilorhynchidae is a small family of peculiar fishes with a comparatively restricted distribution. The distributional pattern of the family, when compared with that of the Homalopteridae or the Glyptosternoid group of the family Sisoridae, indicates its evolution during the Pleistocene and its dispersal and speciation during the late orogenic movements of the Himalayas (Menon, op. cit., MS.). It seems to have crossed over the Garo-Rajmahal Gap during the last glacial epoch about 20,000 tc 10,000 years ago when the height of the gap relative to the then sea-level was probably 500 to 600 feet (Hora, 1951).

These remarkable fishes have been variously assigned to the families Cyprinidae, Cobitidae and Homalopteridae by the earlier ichthyologists and some fishes from China and Indo-China had erroneously been referred to *Psilorhynchus* owing to certain superficial similarities in structure and form with the Indian species. In 1925, the writer (Hora, pp. 457-60) discussed the systematic position of this genus and created a separate family for its reception. Since then, Mukerji (loc. cit.) and Ramaswami (1952) have shown from more detailed morphological studies that its separation into a new family was justified. The salient features of the Psilorhynchidae are :—

1. Absence of barbels and peculiar shape of mouth and of the associated structures (text fig. 1 *d-f*).
2. Presence of a number of unbranched rays in the paired fins (text fig. 1 *d-f*) as in the Homalopteridae.
3. A free air-bladder in the abdominal cavity (text fig. 1 *a-c*) as in the Cyprinidae.

4. A slender pharyngeal bone with teeth (four) arranged in a single row as in the Cobitidae and the Homalopteridae.
5. A plate-like, well-developed and broad basipterygium (text fig. 1 *g*, *h* and *j*) for the attachment of muscles as in the Homalopteridae.

In characters 2, 4 and 5, there is a close parallelism between the families Psilorhynchidae and Homalopteridae, but the structural modifications 2 and 5, though due to the more vigorous use of the paired fins and the muscles associated with them, are correlated with the performance of different functions, as will be shown below.

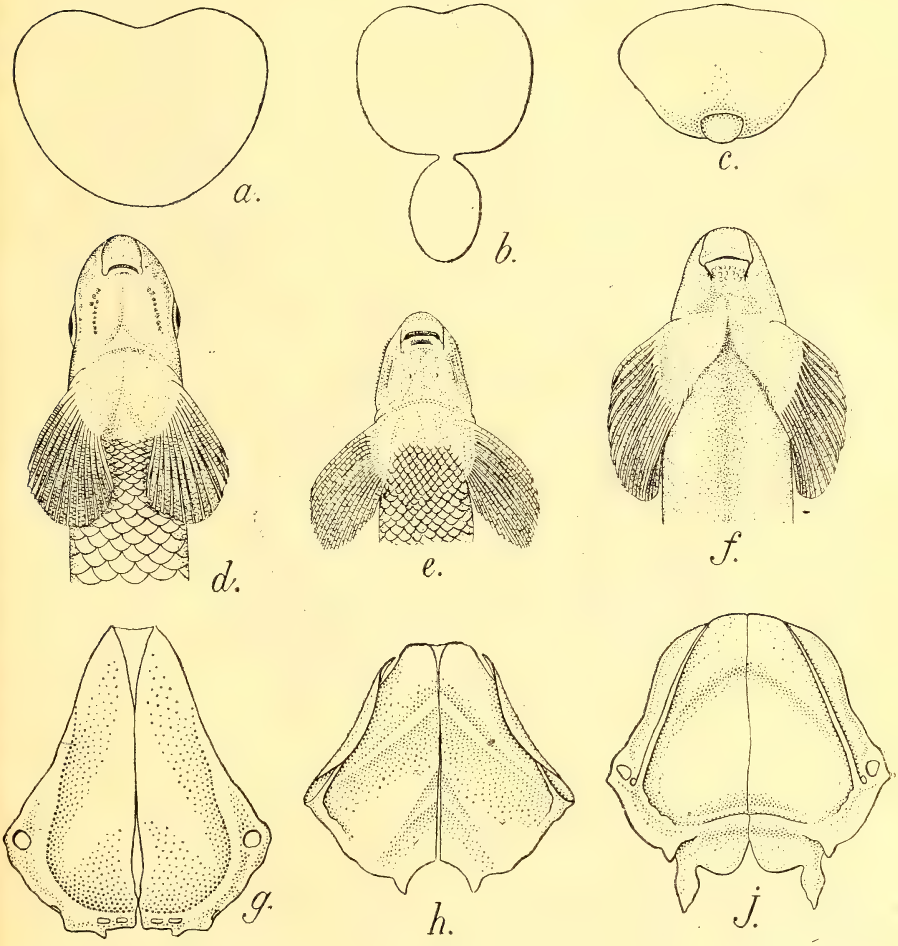

Fig. 1

Hora & Mukerji (loc. cit.) have already referred to the differences in the habitats of the three species and shown how these are correlated with their structural features. For instance, *P. sucatio* is usually met within sandy parts of a brook where it lies partly buried in sand which it displaces with the vigorous action of its paired fins. It is thus not affected by the swiftness of the current to any appreciable extent. As a result of this ground habit of life, the air-bladder (text fig. 1*a*) has deviated from the normal shape and is represented by a laterally extended anterior chamber only. When it lies at the bottom, partly buried in sand, its dorsal streamlined profile offers little resistance to the current and the flattened ventral surface broadly rests on a sandy substratum. There seems little doubt that the unbranched rays in the paired fins of *P. sucatio* (text fig. 2*d*) are used for digging in sandy bottom. Similar structural modifications in the paired fins of the Homalopteridae (text fig. 2*a*) have taken place but for a different purpose—enabling them to cling to rocks. To obviate any damage to the fins, either when used for digging or for adhesion, the unbranched rays are completely segmented to ensure, during operation, pliability with strength. Thus the convergence of structure is carried a step further. In the case of the Homalopteridae, the skin on the ventral surface of these rays becomes padded (text fig. 2*a*) for effective adhesion and the first ray (text fig. 2*b* &c.) becomes broader by the development of a series of cartilaginous processes as are characteristic of the Glyptosternoid fishes (Hora & Silas, 1952) of the family

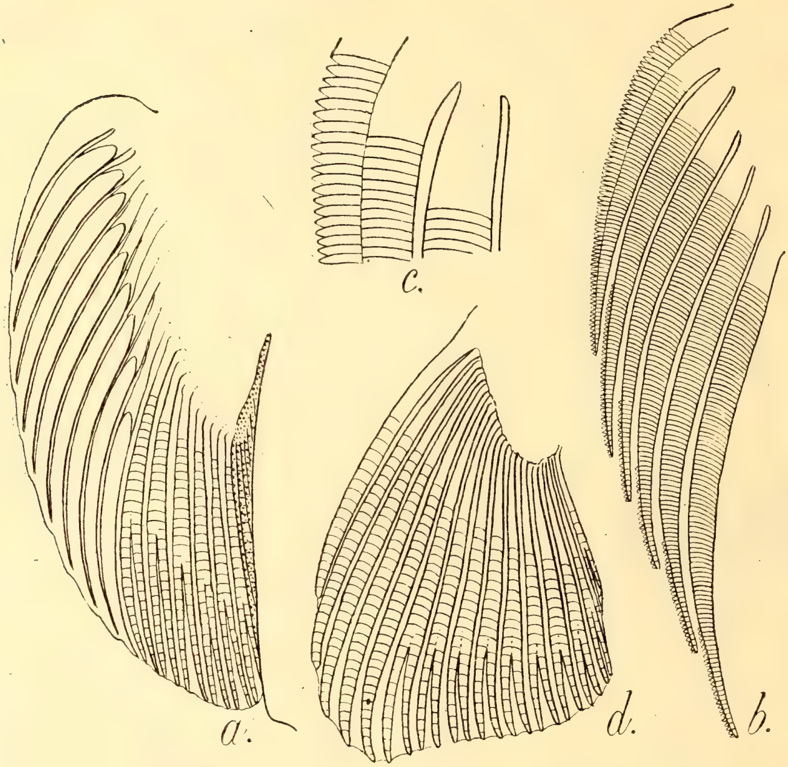

Fig. 2

Sisoridæ. In view of the fact that the pectoral fins of *Psilorhynchus sucatio* are used for quite a different purpose, no adhesive pads of skin are developed on their ventral surface. In an aquarium, however, the fish was noticed to cling to the sides by means of the fins and the flattened ventral surface.

Psilorhynchus balitora (text fig. 1*e*) is cylindrical and loach-like in appearance and I have often collected it from rocky streams. Mukerji (op. cit., p. 830) observed that

> '*P. balitora* is found in the fast streams and shallow rivers of Northern Bengal and Assam, especially where the bottom is rocky. I have never found the fish living in any sluggish stream with a muddy bottom. In the Sevoke Stream and in the shallow, clear and rocky parts of the Mahanadi river, I have observed series of *P. balitora* adhering tightly to the rocky substratum with the expanded paired fins and the chest applied to the rocks. Like other torrential fishes, it always points its head against the flow of the current.'

On the other hand, Kaushiva (1951, p. 164) found specimens of *P. balitora* at Lucknow on a sandy bottom where the water was flowing with some force owing to a weir. There are more unbranched rays in the pectoral fins of this species than in *P. sucatio* and the air-bladder (text fig. 1*b*) is, though somewhat reduced, of the usual Cyprinid type, showing thereby that this species has not yet fully taken to a ground habit of life, though for clinging to rocks or digging in sand it seems to have more efficient pectoral fins than those of *P. sucatio*.

From the observations recorded above, it will be seen that *P. balitora* is equally at home both in rocky as well as in sandy streams. It is, therefore, a more generalised species of the genus. Specimens collected from the rocky streams usually possess skin pads on the ventral surface of the unbranched rays. The paired fins, originally modified for clinging to rocks have secondarily become equally efficient for digging in sand. Thus, this is a case of pre-adaptation, where structures modified for one purpose have turned out to be suitable for another purpose also.

Psilorhynchus homaloptera (text fig. 1*f*), as is implied in the specific name, has become absolutely *Homaloptera*-like in form and structural modifications. There is an increase in the number of unbranched rays to 8 in the pectoral fins and the air-bladder (text fig. 1*c*) is fibrous and reduced. Though no direct observations on its mode of life are recorded, the development of skin-pads on the ventral surface of the unbranched rays of the pectoral fins shows its adaptiveness to cling to rocks in swift currents.

The present-day modes of life of the three species referred to above indicate that *P. balitora* is the central form which can live in sand, as its specific name indicates, but is equally at home on rocks, as observed by Mukerji. It is not yet known which Cyprinoid genus gave rise to *Psilorhynchus* nor is there any indication about the evolution of the type of mouth characteristic of these fishes. The coalescence of the branched rays in the paired fins would seem to have been induced by digging in sand and later found useful for clinging to rocks also. The modifications of *P. sucatio* seem to be directed towards burrowing in sand while those of *P. homaloptera* for clinging to rocks. Thus in these three species we have a remarkable instance of functional divergence associated with structural convergence.

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EXPLANATION OF TEXT FIGURES

Text fig. 1. Air-bladder, ventral surface of anterior part of body and basipterygium in the three species of *Psilorhynchus* McClelland.

a. Air-bladder of *P. sucatio* (Ham.) × 13; *b.* Air-bladder of *P. balitora* (Ham.) × 5 (After Mukerji, 1933) ; *c.* Air-bladder of *P. homaloptera* Hora & Mukerji, × 5 (After Hora & Mukerji, 1935) ; *d.* Ventral surface of anterior part of body of *P. sucatio* (Ham.) × *c.* 1 (After Hora 1921) ; *e.* Same of *P. balitora* (Ham.) × *c.* 1 (After Mukerji, (1933) ; *f.* Same of *P. homaloplera* (Hora & Mukerji, 1935). *c.* × 1 ; *g.* Basipterygium of *P. sucatio* (Ham.). × *ca.* 8 ; *h.* Same of *P. balitora* (Ham.), × *c.* 4½ (After Mukerji, (1933) ; *i.* Same of *P. homaloptera* Hora & Mukerji × *c.* 3. (After Hora & Mukerji, 1935).

Text fig. 2. Pectoral fins of *Balitora brucei* Gray and *Psilorhynchus sucatio* (Hamilton).

a. *Balitora brucei*: ventral surface to show the adhesive pads on the unbranched rays, × 2½ ; *b.* Six anterior rays of *B. brucei* dissected out to show their segmented nature and wing-like cartilaginous extensions on the exposed portions of these rays, × 4 ; *c.* Proximal portions of the anterior two rays of *B. brucei* to show the well-developed cartilaginous extension of the first ray, × 6⅓ ; *d.* *Psilorhynchus sucatio.*

BUTTERFLY COLLECTING IN INDIA

BY

M. A. WYNTER-BLYTH, F.R.E.S.

(*With a coloured plate*)

Perhaps few articles have been begun under conditions more unsuitable to the subject than this. I am camping in a side nala of the Wardwan Valley in Kishtwar and, although it is May 15th, I am, for the third consecutive day, confined to my tent by foul weather. It is snowing heavily, it is bitterly cold, and no conditions less conducive to writing on butterflies can be imagined! However, this is the date upon which the article is due. Conscience, not inspiration, is the spur.

My object is to show that butterfly collecting is no mere childish hobby, but a study of absorbing and deep scientific interest.

Much remains to be discovered about the early stages, distribution, migration, and habits of Indan butterflies, and it is still in the power of the enthusiastic collector to be a pioneer, for it is no exaggeration to state that every collector, no matter where he collects, will after collecting for a few months, have some piece of information or some specimen of value to science.

The naturalist is usually depicted as a bearded old fossil down on his knees peering at something through a magnifying glass, whilst the butterfly collector in particular, an even greater figure of fun, is a be-spectacled professor, head in air, wildly chasing a butterfly, unobservant of the yawning chasm in front of him.

Such pictures should not deter the embryo collector, for though they are no doubt humorous, they are somewhat unjust. If the reader is prepared to undertake a little simple research, he will find that the majority of distinguished naturalists in India, and she has had many, have also made their mark in the services or professions.

At first it will undoubtedly be the beauty, and, to a lesser extent, the variety and abundance, of Indian butterflies that will attract the collector, for there are few Indian butterflies that are not beautiful, and among the 1,400 or so species to be found within the Indian Region[1] are some of the most beautiful in the world.

An interesting experiment that I once carried out on the relative beauty of Indian butterflies may serve as an illustration to this statement. I chose some 40 of what I considered to be the most beautiful of them all, selected with an eye to suit all tastes. I then asked 11 of the inhabitants of the place in which I was stationed, people of various nationalities, occupations, social standing and levels of intelligence, to choose in order what they thought to be the six most beautiful—first choice receiving 6 points, second 5 points and so on. Amongst these butterflies was *Prothoe calydonia,* the Glorious Begum (see plate), an extremely rare butterfly from Burma that is often referred to as the most beautiful butterfly in the world. In the final count the interesting fact was that this butterfly only gained 6th place. The final placings were as follows:—

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[1] That is India, Pakistan, Ceylon, Burma, Nicobars & Andamans.

(1) The Blue Peacocks [*Papilio polyctor, P. arcturus* (see plate), *P. paris* and *P. krishna*, of which the favourite was *P. polyctor*].
(2) The Kaisar-i-Hind (*Teinopalpus imperialis*).
(3) The Banded Peacocks (*Papilio crino* and *P. buddha*).
(4) The Orange Oakleaf (*Kallima inachus*).
(5) The Birdwings (*Troides*).
(6) The Glorious Begum (*Prothoe calydonia*).
(7) The Clipper (*Parthenos sylvia virens*).

and thereafter in order the Bhutan Glory (*Armandia lidderdalei*), the Yellow Gorgon (*Meandrusa payeni*), and the Large Oakblue (*Amblypodia amantes*) as representing the numerous Oakblue genus.

The Blue Peacocks gained first place very comfortably, seven of the eleven selectors placing them first. The favourite, *P. polyctor*, the Common Peacock, is an abundant butterfly at Himalayan hill stations and very much a feature of gardens during the spring and rains. *Papilio arcturus*, the Blue Peacock, is my own particular favourite in this group, perhaps because of its association with the higher hills, for the differences between it and *polyctor* are very minor.

When the collector has caught and named the majority of the common butterflies of his locality and has attained some proficiency in identifying the scarcer species, he will begin to find that the study of butterflies is absorbing in many ways in addition to the mere novelty of catching new species and taking pleasure in the appearance of those that he has caught, though these pleasures will always remain. One of the first things to intrigue him must be the variation that so many butterflies display—between individuals of the same sex, between the two sexes, and, especially, between the dry season and wet season broods.

For example, the undersides of no two *Kallima*, or Oakleaf Butterflies, are ever identical, and the variation in markings on the uppersides of *Catopsilia pomona*, the Lemon Emigrant, a very common garden butterfly, is great. The males and females of most butterflies show some difference in marking, colouration or shape of the wings, though in a number of species the wing markings are identical and sex can only be determined by examination of the genitalia or the structure of the legs. Where the sexes differ considerably—and the rule is that the male is the brighter in colour whilst the female has the drabber or more confusing markings—sexual selection in the males has proved stronger than natural selection which has given the female her protective markings. Usually it is easy enough to recognise that such males and females belong to the same species, but there are numerous butterflies that have a female form or forms that are entirely different from the male, for instance—once again choosing a very common garden butterfly—the male of *Hypolimnas misippus*, the Danaid Eggfly, is a handsome black insect with a white egg-shaped blue-edged marking on each wing, while the female is brick red with black and white markings bearing at first sight no resemblance at all to the male.

More interesting still is seasonal variation caused by the effects of different conditions of moisture and temperature on the caterpillars and their foodstuffs. As a general rule butterflies reared during the rainy season when plant growth is at its richest are smaller, darker and less protectively marked—the struggle for existence being at a lower ebb during this season of plenty. Butterflies reared during the dry season are larger, paler and more obscurely marked, and their wing contours are often angular.

Most of the genus *Ypthima*, the Rings, common little brown butterflies which hop about close to the grass, are richly marked with rings, or 'eyes' (ocelli), and fine streaking, or 'striations', on the undersides in the wet forms, whereas these markings are reduced to mere silver specks in the dry forms and the striations disappear. Again, *Melanitis leda*, the Common Evening Brown, an abundant butterfly that dances briskly about as dusk falls and often comes in to verandah lights, has a finely striated underside with ocelli in the wet form, which markings entirely disappear in the brood reared during the dry season, to be replaced, often richly, by brown, yellow and black blotches or bands like the patterns on old leaves lying on the ground. To add to the resemblance the contour of the wings becomes much more angular and the insect bends the wings over sideways when settling.

There are two more interesting examples worthy of mention. *Terias laeta*, the Spotless Grass Yellow, and its wet season form *venata*, were long classed as different species, so dissimilar were they in appearance, until Colonel Mosse proved them to be the same by breeding *laeta* from eggs laid by *venata*.

Catopsilia pyranthe, the Mottled Emigrant, and *Catopsilia florella*, the African Emigrant, are two extremely common greenish-white medium-sized garden butterflies, the former flying in the monsoon and early autumn, the latter at the other seasons. They do not differ greatly but are easily recognised the one from the other. Now, though circumstantial evidence is very strongly in favour of their being two forms of the one species, this has never been *proved*. As the foodplant is known, one would think it would be an easy matter to secure the necessary proof by capturing a female, keeping her with her foodplant and seeing what the eggs bring forth. Unfortunately many butterflies are unwilling to lay eggs in captivity.

Another matter that must quickly claim the interest of the collector is the patterns on butterflies' wings and the reasons for them. These patterns may roughly be divided into three categories: protective, warning and attractive. Almost all butterflies are protectively marked on the undersides; many on the uppersides as well. The aim of such markings is to make it hard for their enemies to see them. On the undersides they may resemble some specific object, such as *Kallima*'s wonderful imitation of a leaf, or as the silver-spotted Fritillaries (*Argynnis*) resemble the sparkling morning dew, for early morning is the time that these high altitude butterflies are numbed with cold and find it hard to fly. But the majority have cryptic patterns that blend with the background against which they settle. It will be noticed that such markings on the underwings invariably cover the whole of the hindwings but very frequently only the tips of the forewings, for when many butterflies settle the forewings are folded back into the hindwings so that only their tips remain uncovered[1].

Certain butterflies carry warning colours, usually combinations of red, yellow and black. These are either butterflies that are actively protected by a taste (derived from the plants on which their caterpillars fed) that is offensive to their enemies (birds and lizards), or butterflies that by a process of natural selection have come to imitate, or 'mimic', the evil-tasting species for their own protection. In the first group, amongst others, is the genus *Danais* (which contains the brick-red, black and white Plain Tiger, *D. chrysippus*, perhaps the commonest of garden butterflies on the plains). The butterflies of this genus display the warning colours on the upperside, for when they settle to sip the nectar of plants they do so with their wings spread. But another genus, *Delias,* the Jezebels, which settles at such times with wings closed, bears brilliant black, red, and yellow markings on the underside. In the second group perhaps the commonest is the female of the aforementioned *Hypolimnas misippus* which mimics *D. chrysippus*. *Chilasa agestor,* the Tawny Mime, a mimic of *Danais tytia,* the Chestnut Tiger, is shown on the plate. These two are butterflies that can be seen at Himalayan hill stations.

In passing, perhaps it is of interest to notice that 'protected' butterflies fly slowly to give their potential enemies time to see and recognise that they *are* distasteful species, and furthermore they are always very tough and tenacious of life (as the collector will learn when he tries to kill them), so that if a bird does make a mistake and rejects the insect in disgust, little damage may result!

The upperwings of butterflies show an almost endless variety of colours and patterns. The faster flying species such as *Eriboea dolon,* the Stately Nawab, (figured on the plate) make little attempt at protection, but the majority bear some sort of confusing, concealing or disruptive pattern suited to their type of habitat—for instance the basic colour of almost all forest haunting butterflies is drab brown (genera such as *Lethe,* the Treebrowns, and *Mycalesis,* the Bushbrowns), and favourite patterns for those that love patchy sunlight and shade are horizontal bands of black and white, or black or brown and yellow (e.g. genera such as *Neptis*, the Sailers, and *Pantoporia*, the Sergeants), obviously a successful pattern as it is mimicked by a butterfly, *Apatura chevana*, the Sergeant Emperor, a member of a genus whose general pattern bears no relationship to it at all. This is, I believe, the only case of mimicry among Indian butterflies where the pattern, or object of imitation, is not a 'protected' butterfly—that is one protected by unpleasant taste.

In the third category—butterflies with attractive colours or markings—the uppersides of the males show no attempt at protection; indeed, quite the reverse, for every attempt is made to render them conspicuous on the wing. This is apparently the result of sexual selection, the importance of attracting the female being paramount and more powerful than the influences of natural selection that would

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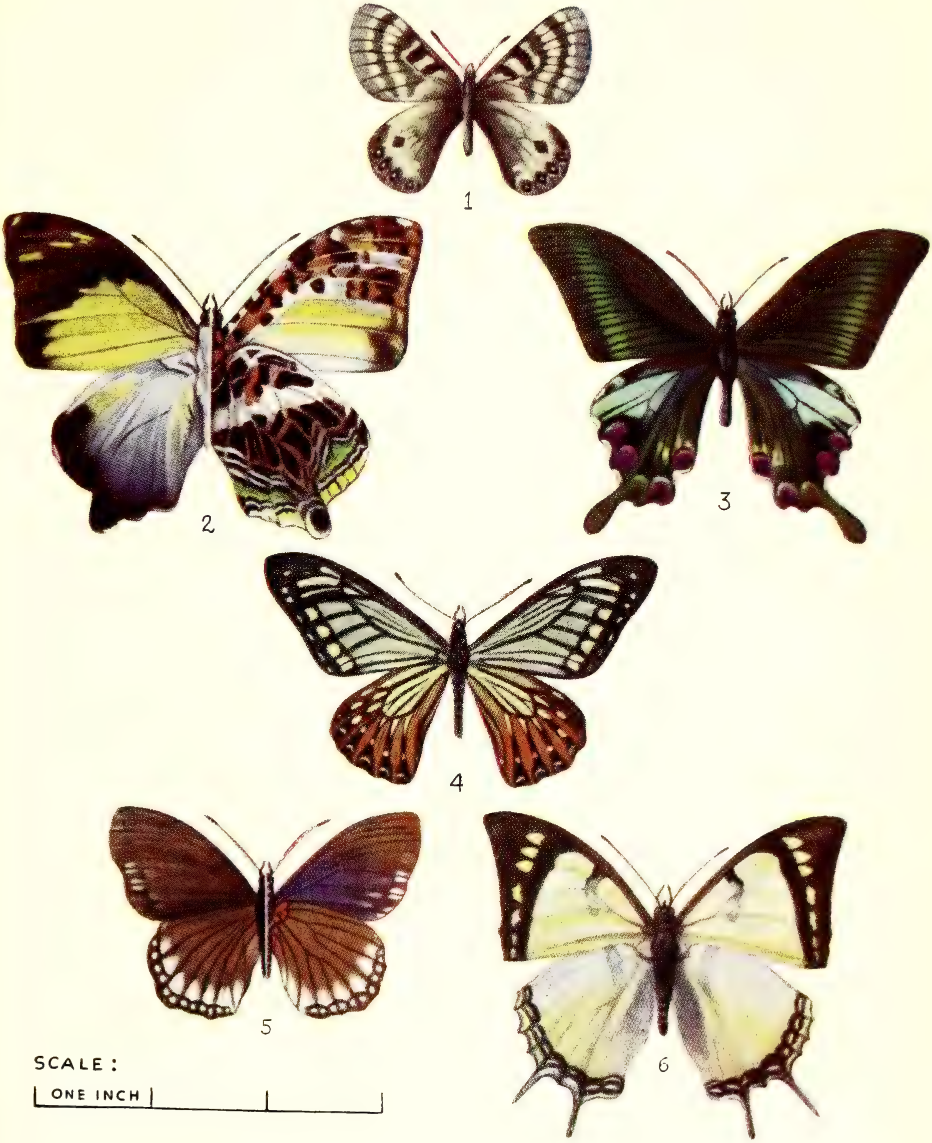
[1] Almost all butterflies go to rest with the wings in this position.



1. The Banded Apollo, *Parnassius stoliczkanus*, race *nova*, male
2. The Glorious Begum, *Prothoe calydonia belisama*, male UP UN
3. The Blue Peacock, *Papilio arcturus arius*, male
4. The Tawny Mime, *Chilasa agestor govindra*, male
5. The Painted Courtesan, *Euripus consimilis*, form *nova*, female UP UN
6. The Stately Nawab, *Eriboea dolon centralis*, male

produce some protective colour pattern. Such butterflies gain protection in other ways, such as by fast flight or, in the case of many 'blues' (*Lycaenidae*), by strongly contrasting colours on the upper and lower sides, so that, though in flight they present one appearance, immediately they settle with their wings closed they present an entirely different one, thereby utterly confusing their pursuers. The Blue Sapphire, *Heliophorus oda*, a beautiful little butterfly that is not rare in the N.W. Himalaya, serves as an excellent example of both sexual selection and contrasting coloration. In the male of this species the upperside is of a brilliant deep silky blue with black borders to the forewing and red borders to the hindwings, a colour scheme that flashes in the sunlight and makes the butterfly very obvious in flight, but the underside is of a rich orange brown. The female is the same below but orange and black above.

Mimicry has already been mentioned in relation to colour schemes, and so much has been written about this fascinating subject that I do not intend to say more than a word or two about it. Mimicry, to state the obvious, is where a species of butterfly by a process of natural selection has grown to resemble another for its own protection—a protection in the case of mature butterflies that is almost entirely against birds and lizards. How does this mimicry deceive the human eye? Speaking as a collector my answer is that it does so very seldom. Wonderful though most examples of mimicry may be, after a little experience it is usually easy to pick out the mimic in flight from its pattern. Perhaps the most perfect example of mimicry among Indian butterflies is that of the Danaid Eggfly, *Hypolimnas misippus*, the female of which mimics the Plain Tiger, *Danais chrysippus*. In this case considerable experience is required to tell the butterflies apart in flight—and even so one is often deceived.

It should, perhaps, be stressed that mimicry and protective resemblance are measures against birds and lizards, and to a lesser extent against frogs and toads, but not against insect enemies. The sight of insects is entirely different from that of ourselves, birds, reptiles and amphibians, and as insects rely mainly on other senses for finding their prey, mimicry and protective resemblance are no defence against them. Other measures have to be adopted. Though in the imago—final, or butterfly, stage—insect enemies are of small importance (chiefly dragonflies, robberflies or Asilidae, and Mantids), in the earlier stages, as I shall mention shortly, they are many.

Perhaps one problem of mimicry should be mentioned. To gain the needed protection one would obviously assume that the mimic and the pattern should fly together. Yet this is not always the case. The *romulus* form of the female of the Common Mormon (*Papilio polytes*) that mimics *Polydorus hector*, the Crimson Rose, is found north of the range of the latter in both Kathiawar and the Simla Hills. However, as these areas are not so very far north of the habitat of *hector* this can probably be explained by local migration. The case of *Valeria valeria hippia*, female form *philomela*, the Common Wanderer, a species found in S. India, that mimics *Danais aspasia*, a butterfly that can be met with no nearer than Burma, is much more difficult to explain. One distinguished naturalist put forward a theory that the selective agent is some species of wagtail that migrates between India and Burma. Sálim Ali, however, thinks nothing of this theory as he knows of no such wagtail and furthermore considers that a wagtail is a most unlikely kind of bird to serve as a selective agent for a fast flying butterfly such as *Valeria*. More probable solutions are that *Valeria* is a persistently migrant butterfly (though I have no evidence of this except that its trivial name, the Common *Wanderer,* leaves a suspicion that it may be a migrant) or that its pattern and its mimic originally flew together in the south (and other parts of India, for it is also found in Bengal, M.P., and Assam) but some change of climate or other condition eliminated *aspasia* from that region but left *philomela*.

One of the most attractive things to my mind about butterfly collecting—but this applies mainly to the north of India and especially to the N.W. Himalaya where the seasons are pronounced—is the discovering, in the case of single or double-brooded butterflies, of the dates on which the broods may be expected to appear, for they are often most remarkably regular in appearance. When this applies to butterflies that can only be found in certain very particular localities their pursuit becomes even more intriguing. Two such butterflies are featured on the plate—*Chilasa agestor*, the Tawny Mime, and *Eriboea dolon*, the Stately Nawab. Indeed, it was the first-mentioned that induced me to take up butterfly collecting. Shortly after arriving in Simla, that fine naturalist A. E. Jones showed me a picture of it and said that it was the earliest of the 'good' butterflies to be caught in Simla. It could be found for a fortnight, from the last week of March, in a very small number of select localities—one of which, I remember, was near the then Japanese Consulate. Although it took me two years to come across it and to catch it, nevertheless this was the butterfly that started me off on butterfly collecting in India.

Eriboea, the genus to which the Stately Nawab belongs, the closely allied genus *Charaxes*, the Rajahs, and one or two others, may be regarded as the 'big game' of the Indian butterfly world. Their capture is a matter of experience, knowledge and strategy. To catch this particular butterfly a knowledge of the precise locality, exact season, and particular time of day that it flies is needed. A further complication is that it flies very fast indeed and seldom approaches within 12 or 15 feet of the ground, but this can be overcome by the fact that its range is very restricted and if the collector climbs a tree within this small area he will have an excellent chance of catching not one, but two or three at once, for they are extremely quarrelsome butterflies and fight in two's and three's, at which time they are oblivious to their surroundings and pay no attention to the collector and his net.

The collector will probably wish to know what are his prospects of catching a new species—and so fulfilling the dream of every naturalist. In India the chances are almost nil. In Assam and Burma they are very, very remote. In a paper collection from Burma bought by me in Ooty I was fortunate enough to discover the new female form of *Euripus consimilis*, the Painted Courtesan, that is shown on the plate. This parallels one of the female forms of the very closely related *Euripus halitherses*, the Courtesan (♀ form *cinnamoneus*). Such discoveries as this are nowadays very rare.

If, on the other hand, the collector cares to investigate carefully some of the high valleys of the Himalayas he has a very good chance indeed of discovering new races of certain species—and by races we mean butterflies that in a certain locality show slight but constant differences from others of their own species in an adjacent locality. The valleys there are so isolated from one another that species can follow their own line of development with little infiltration of fresh blood from outside to interfere with them. The three species to which these remarks mainly apply are *Parnassius delphius, P. stoliczkanus* (inhabitants of above about 13,000 ft.), and the Lycaenid, *Polyommatus eros*, found above about 8,500 ft., all of which run to a large number of races. A new race of *Parnassius stoliczkanus* is shown on the plate. This flies on the Shiring La, the pass that is one stage beyond Shipki. A. E. Jones and I had an arrangement with a trader who went yearly over the passes to Gartok by which his men collected butterflies for us. Opening the parcels of butterflies he sent to us was most exciting. Many were the good butterflies he brought back—*Parnassius stoliczkanus spitiensis, P. acco, P. simo, P. charltonius, P. ephaphus. Baltia butleri, Pieris callidice, P. chloridice, P. deota, P. krueperi,* high elevation *Polyommatus* and Satyrids, and on one occasion a very long series of this new race of *Parnassius stoliczkanus*.

* * * * *

So far I have touched, and touched but lightly, on a very few points of interest regarding the imago, or final stage of butterfly life; but it should not be thought that the early stages are without interest. Far from it, for it is in this field that many discoveries can be made. The early stages of few Indian butterflies have been described—and the vast majority of those that have been described were described by one pioneer, T. R. Bell of Kanara, whose researches were published in this journal under the title of 'The Common Butterflies of the Plains of India'.

As well as the discovery of the caterpillars and foodplants of butterflies whose early stages have hitherto remained undescribed, there is a multitude of other things of interest about the eggs, caterpillars and chrysalids. The study of the association between ants and the caterpillars of many Lycaenids is of absorbing interest. In its most highly developed form ants take complete charge of the development of the butterfly from the egg stage until the emergence of the perfect insect, all of which care is administered in return for a sweet secretion that these caterpillars exude from segment 11 of their bodies.

Most Lycaenid larvae also have two small organs on segment 12, one on each side, in the form of pillars, which can be erected at will. In the larvae of *Curetis*, the Sunbeams, however, these pillars are large and permanently erected. When one of these larvae is touched or frightened, from each of the pillars is protruded a long tentacle furnished at its head with a brush of parti-coloured hairs which opens out into a rosette. The tentacle is whirled around with immense rapidity producing a curious effect. This contrivance is undoubtedly an apparatus for frightening away enemies. Now the Sunbeams do not possess the gland on segment 11 and therefore are afforded no protection by ants. Consequently it seems probable that the organ on 11 was developed later than that on 12 and that on most larvae the organ on 12 is only a relic of an old form of defence, and since it has ceased to be of use for its original purpose it has become aborted. There is a theory that in its present degenerate condition it is used as a signal to ants that the sweet liquid from the gland in 11 is ready for the taking, but I do not think that this need be considered seriously.

Generally larvae are very particular about their choice of food-plants, often feeding on only one particular species of plant. But this does not apply to butterflies constantly attended by ants for more often than not they are found to feed on a large variety, attention by ants apparently being of more importance than the type of food. Such caterpillars cannot be reared away from the ants that usually attend them.

On the other hand, there is the caterpillar of the very rare Moth Butterfly, *Liphyra brassolis,* that, clothed in impenetrable armour, also lives in ants' nests, not to be ministered to by them but to feed on the ant larvae. This species also pupates in the ants' nests—still in his armour plate—and emerges there. This surely is the moment when he may well be vulnerable to the attacks of ants? But no; the young imago is covered with detachable and adhesive scales in which the attacking ants become entangled and so are rendered impotent.

The study of the numerous enemies and parasites that the early stages of butterflies are heir to is a subject of great scope. To mention but a few, spiders and cockroaches eat their eggs, ichneumon flies, mason wasps and a host of others lay their own eggs within the caterpillars, the chrysalids are far from safe from birds and lizards, and frogs and toads will eat greedily the eggs, caterpillars or chrysalids when they find them. What then are their measures of protection? Unlike the imago the early stages are more or less static, and so protection against the more slowly moving insect enemies becomes of great importance. Although butterflies' eggs are minutely sculptured to look like tiny plant galls the main method of protection of the species in this stage lies in the laying of very large numbers in the hope that at least a few will survive. In the caterpillar stage the methods of protection are many. Some, like the perfect insects, are protected by unpleasant taste and smell and bear warning markings and feed openly for all to see. Others, the *Papilios*, or Swallowtails, feed on citrus plants, whose essential oils are generally considered to be a deterrent to insects—nevertheless the early stages of some of these butterflies are far from free from insect parasites. But the larvae of the *Charaxes-Apatura* group of the Nymphalids and those of the Danaids, employ more direct methods in dealing with them, for the former have fleshy processes on their heads, and the latter on segments 3 and 12, which are probably used for brushing them off. Many Nymphalids have spined larvae, and often these, and those too that are protected by unpleasant taste or smell, live in colonies, on the assumption, perhaps, that though one hairy or unpleasant tasting caterpillar may not be a too unpleasant mouthful, several will certainly be so and something no bird will wish to repeat! Many caterpillars only feed by night, most feed on the undersurface of leaves, and the majority, like the perfect insects, bear protective colour patterns or processes. To mention one or two: *Euthalia* (a very large genus of the Nymphalidae) carry fern-like processes that make them resemble the midrib and veins of a leaf, some Swallow-tail (*Papilio*) larvae resemble birds' droppings, and the larva of *Limenitis procris*, the Commander, builds up a rampart of its own droppings and perfectly resembles these. Skippers (Hesperiidae) live in cells made from leaves or blades of grass.

Chrysalids mainly depend on the protected position in which they are placed, on their obscure markings, on their shapes and, especially, on their hard chitinous coverings that guard them from most of their insect enemies.

* * * * *

But, perhaps, after all, one of the greatest charms of butterfly collecting lies in the beauty of real butterfly country—the high meadows and passes of the Himalayas in July where the labour of attaining such places is richly rewarded by the gardens of flowers in which fly *Parnassius* and other prizes of the butterfly world; the lovely nalas above the Himalayan hill stations in May and June; and, throughout the year, the South Indian jungles at the foot of the hills where insect life is unbelievably rich.

Above all, butterfly collecting is a hobby for those who seek peace of mind, solitude, and beauty.

NEW FINDS OF INDIAN CUCURBITACEAE

BY

H. L. CHAKRAVARTY D.SC. (Edin.), F.L.S.

Professor of Botany, Presidency College, Calcutta

(*With five plates and a text figure*)

During the preparation of a monographic work on Indian *Cucurbitaceae* in Great Britain, attached to the University of Edinburgh, I came across nine new species and one new genus of the family. The new finds together with those recorded by Clarke in Hooker's Flora of British India will now come to a total of 108 species which mean an increase of 37 species from Clarke's list. Thirty-four genera have been included in the Monograph, while in F. B. I. we find only 29. The new genus *Neoluffa* has been discovered from Sikkim Himalaya. It approaches towards *Luffa* in certain aspects but differs in having (i) leaves entire and tomentose without punctation, (ii) petals constricted at the apex and (iii) stamens all free but four arising closer as if in two pairs. The monograph is being published elsewhere.

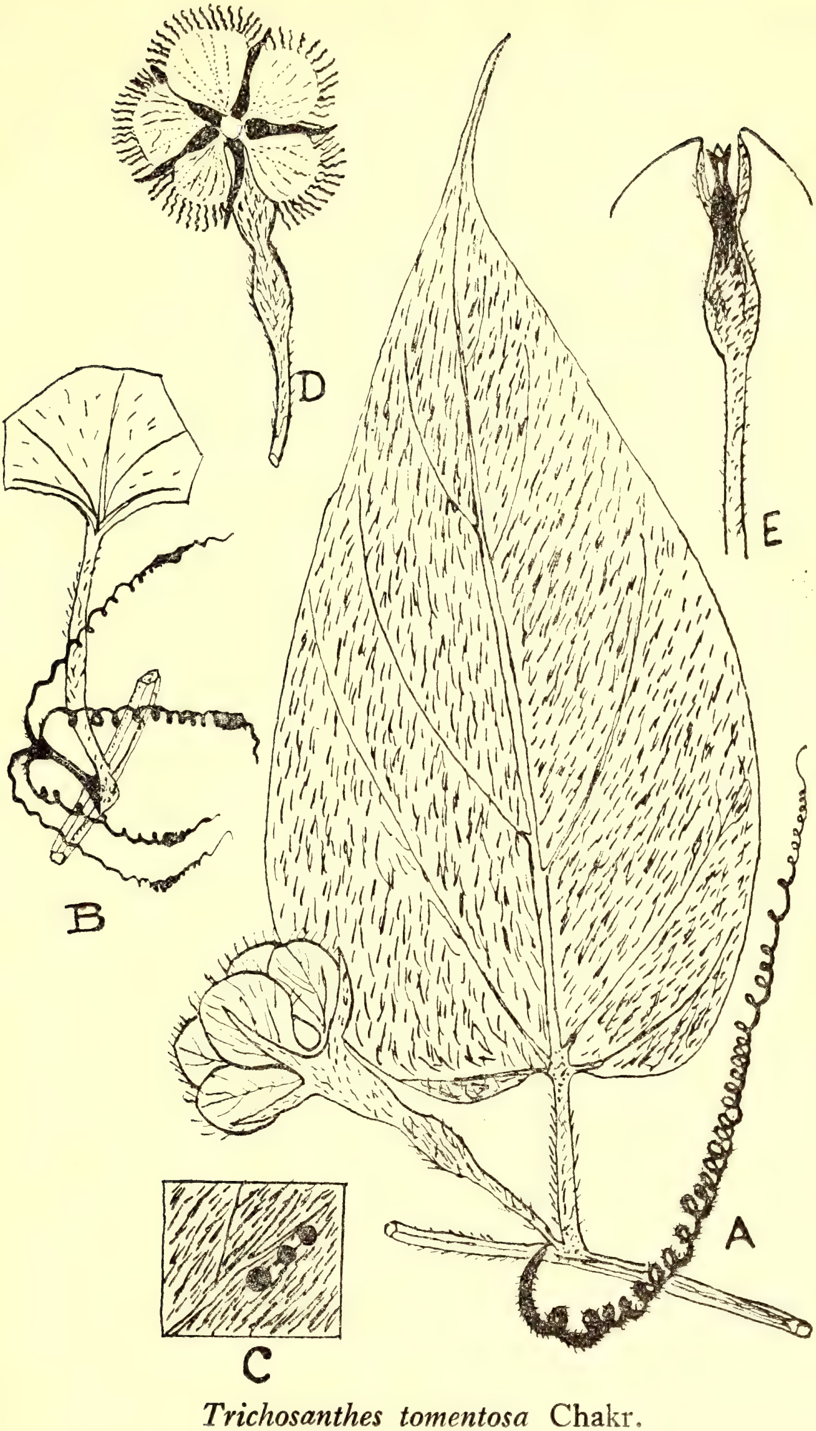
Trichosanthes tomentosa Chakravarty, sp. nov.

Ab omnibus speciebus hujus generis adhuc descriptis propter folia subtus dense tomentosa valde distincta; affinis speciei infra notatae esse videtur.

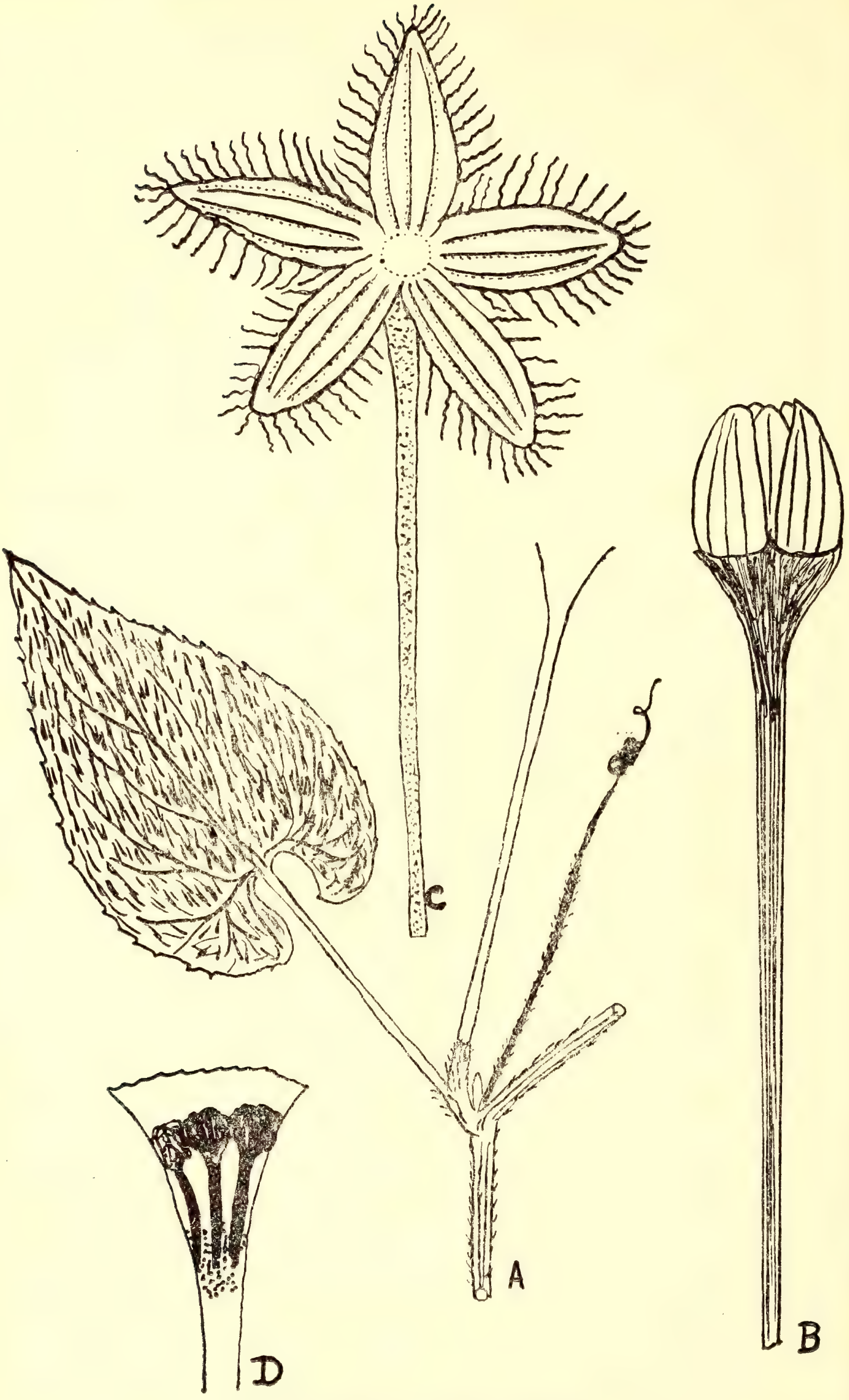
Caulis robustus, elongatus, angulato-sulcatus, fulvo-hirsutus. Folia magna ; lamina supra atro-viridis, sparsim atque breviter hirsuta, subtus densissime coacto-tomentosa, glandulis cupularibus paucis conspersa, ovato-lanceolata, truncata vel paulo cordata, margine integerrima vel remote et obscure serrata, 10–20 cm. longa, 6–10 cm. lata, apice longe acuminata, ad basim nervis ornata 3–5, petiolo robusto, tomentoso, 2–5 cm. longo praedita. Cirrhi robusti, hirsuti, simplices vel basi 4–5-fidi, 5–15 cm. longi. Pedunculus femineus ± robustus, axillaris, solitarius, uniflorus, tomentosus, 2–4 cm. longus. Calycis tubus tomentosus, 8–12 mm. longus, 4–6 mm. latus, 5-lobatus; lobi lineares extra tomentosi, 10–12 mm. longi, 1·5–3 mm. lati. Petala 5, spathulata, unguiculata, ad marginem fimbriata, 10–15 mm. longa et lata. Ovarium oblongum dense molliter tomentosum, apice basique ± contractum. Stylus crassus, niger in sicco, 1·5–2 mm. longus, 1–1·5 mm. latus; stigma 3-lobatum, lobis linearibus 2–3 mm. longis. Flores masculi ignoti. Fructus deest.

Assam: Kohima to Nerhema 4,500 ft. (*Watt.* No. 11640 type: 22nd May 1895, Herb. Cal.); Naga Hills, Mongsendi 5,000 ft. (*Watt.* No. 1129, May 1895, Herb. Cal.).

Four sheets of this species are in the Calcutta Herbarium, three collected from Kohima and one from Naga Hills. This species can be easily distinguished from its allies by its densely tomentose leaves.



Trichosanthes tomentosa Chakr.



Trichosanthes listeri Chakr.

Trichosanthes listeri Chakravarty, sp. nov.

Haec species cum *Trichosanthe tomentosa* Chakravarty quoad faciem congruit sed foliis multo minoribus, supra scabrido-hirsutis, floribus multo majoribus, tubo calycis longissimo discrepat.

Caulis satis robustus, elongatus, angulatus, longe hirsutus. Lamina crassa, indivisa, ovata vel ovato-lanceolata, alte cordata, apice acuto, margine minute denticulato, supra dense scabrido-hirsuta, subtus densissime et molliter tomentosa, 6–8 cm. longa, 4–5 cm. lata; lobi ad basim cordatam ± rotundi, 1–2 cm. lati; petiolus cylindricus, hirsutus, 3–6 cm. longus. Flores masculi ebracteati, axillares, magni; pedunculus hirsutus, uniflorus, 1·5–2 cm. longus. Calycis tubus breviter tomentosus, 8-12 cm. longus, linearis, apice latior et campanulatim expansus, regione angusta 2–3 mm. lata, regione expansa 2–2·5 cm. lata; lobi 5, ± 5 mm. longi, acuti. Corolla expansa ad basim partita, longe fimbriata; lobi oblongo-ovati, glabri, 4–5 cm. longi, 1·5–2 cm. lati. Stamina 3, unum uniloculare, duo bilocularia, ori tubi calycini inserta; filamenta 1–1·2 cm. longa; antherae sinuatae; connectiva lata, rugulosa, undulata 4–5 mm. longa et lata. Flores feminei et fructus ignoti.

Bengal: Chittagong Hill Tracts, Burkul (*Lister*, No. 349, 4th March 1876. Herb. Cal., *Type*).

This species can easily be distinguished by its very thick tomentose and deeply cordate leaves and large flowers with very long calyx tube.

Neoluffa Chakravarty, gen. nov.

Genus affine *Luffae*, a quo foliis integerrimis haud scabro-punctatis infra tomentosis, petalis ovatis, apice angustatis nec rotundatis, staminibus aliter dispositis, uno libero, quatuor per paria insertis imprimis divergit.

Herba scandens. Cirrhi plerumque bifidi. Folia cordata eglandulosa. Flores fere certe dioici, flavi, in fasciculis plurifloris ad cacumina ramulorum longorum dispositi. Bracteae parvae, foliaceae, eglandulosae. Calycis tubus (receptaculum) campanulatus, non-turbinatus, patulus. Petala libera, patula, ovata. Stamina 5, filamentis liberis hoc modo collocata (1+1) + (1+1) + 1 omnia ad tubi calycini basim inserta; antherae 5, liberae, exsertae, 1-loculares, loculis sigmoideo-flexuosis, connectivis crassis granulatis.

Species one. Habitat in Eastern Himalaya.

The genus approaches *Luffa* in certain features but differs in having (i) leaves entire without punctation on the upper surface and tomentose lower surface, (ii) petals constricted at the apex, (iii) stamens one free and the rest four arising in two pairs.

Neoluffa sikkimensis Chakravarty, sp. nov.

Herba annua. Caulis 5-angulosus ferrugineo-tomentosus. Petiolus 5-8 cm. longus, breviter tomentosus; lamina cordata, supra glabra, subtus minute coacto-tomentosa, 7–15 cm. longa et lata, margine integerrimo, nervis duobus infimis secundum marginem loborum basalium currentibus. Flores masculi flavidi, racemis fasciculatis ad apices pedunculorum longorum axillarium dispositis; pars florifera 3–5 cm. longa; flores 20-35 in singulis racemis, pedicelli 1–2 cm. longi;

bracteae foliaceae 7–15 mm. longae, pedunculo infra per circ. 8–14 cm. nudo. Receptaculum campanulatum 1–1·5 cm. diametro, tomentosum, alternatim nigrum et fuscum ; calycis lobi acuti 3–5 mm. longi incisi. Petala oblongo-ovata, integerrima, ad apicem ± constricta, acuta, 8-10 mm. longa, 3–4 mm. lata. Stamina libera, tubo calycis ad basim inserta, 1–2 mm. longa, filamentis 0·5–1 mm. longis; antherae 1-loculares, sinuatae, connectivo lato granulari. Pollen globosum. Flores feminei et fructus ignoti.

Sikkim Himalaya: near Sittong 1,500 ft. (*King*, 12.5.76 Type at Calcutta Herbarium.)

This is an interesting species of Cucurbitaceae. Three sheets of the specimen were collected by George King as far back as 1876 from Sittong in the Eastern Himalaya near Mongpu. No specimen of the female plant is available. The general appearance of the plant particularly of the leaves gives an illusive resemblance to *Argyreia* (Convolvulaceae). It shows a near approach to *Luffa*, hence the name *Neoluffa*, but certain dominant features like the inflorescence, the stamens and the leaves are at variance with *Luffa*. The female plant when procured will throw further light on its affinity. C. B. Clarke in 1895 seems to have examined the flowers and remarked on its affinity with *Luffa amara* (?) but he expressed doubt of its generic position.

Cucumis hystrix Chakravarty, sp. nov.

Species affinis *Cucumi prophetarum* Linn. a quo foliis majoribus haud alte trilobis, fructibus oblongis nec globosis differt.

Caulis repens, elongatus, ramosus, angulato-sulcatus, pallido-viridis, sparse hirsutus. Foliorum petiolus dense atque breviter cinereo-hirsutus, 2-4 cm. longus; lamina ovata, aliquando leviter trilobata, utrinque ± dense hirsuta, supra intense viridis, subtus pallidior, margine minute denticulato, basi ± cordata vel truncata, apice acuto, 4–7 cm. longa, 3·5–6·5 cm. lata. Cirrhi simplices, breviter hirsuti. Flores ignoti. Fructus oblongus, aculeis 1–2 mm. longis, multis, munitus, 3–3·5 cm. longus, 1–1·7 cm. latus. Semina obovata, haud marginata, 3·5–4·5 mm. longa, ± 2 mm. lata, ± 0·2 mm. crassa, pallido-flavescentia.

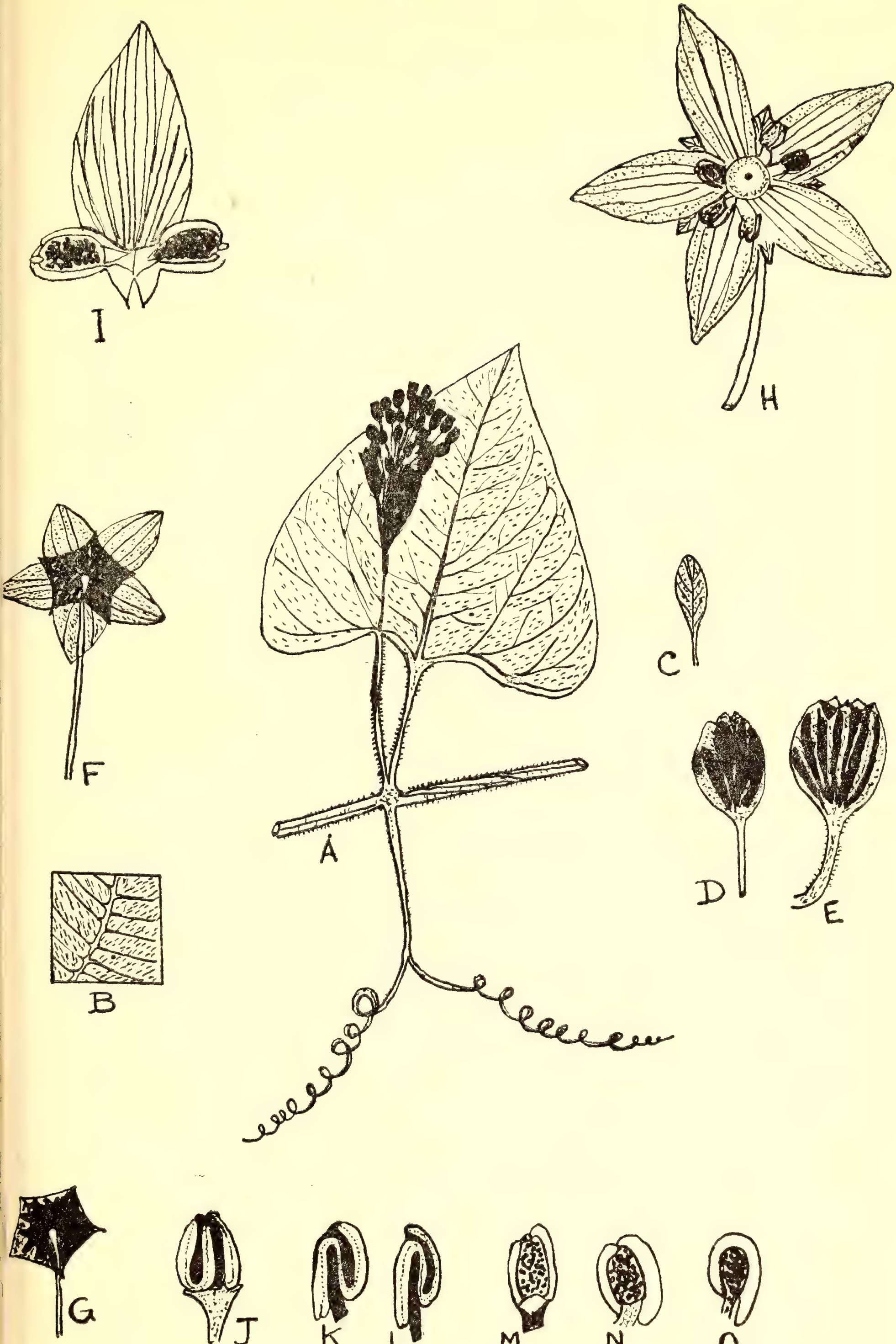
Assam: Garo Hills, Tura Mountain 3,000 ft. (*N.E. Parry*, No. 859 Herb. Kew, type, November 1929); Mishmee Hills (*Griffith* No. 2554 Herb. Kew, 1862-3 ex Herb. East India Company).

This species is distinct from the rest of its Indian allies except *Cucumis prophetarum* Linn. which is principally a species of the arid part of the Mediterranean region although it extends to Western India. Both have a prickly fruit but *C. prophetarum* has much smaller leaves usually deeply lobed and also a globose fruit—not elongate as in *C. hystrix.*

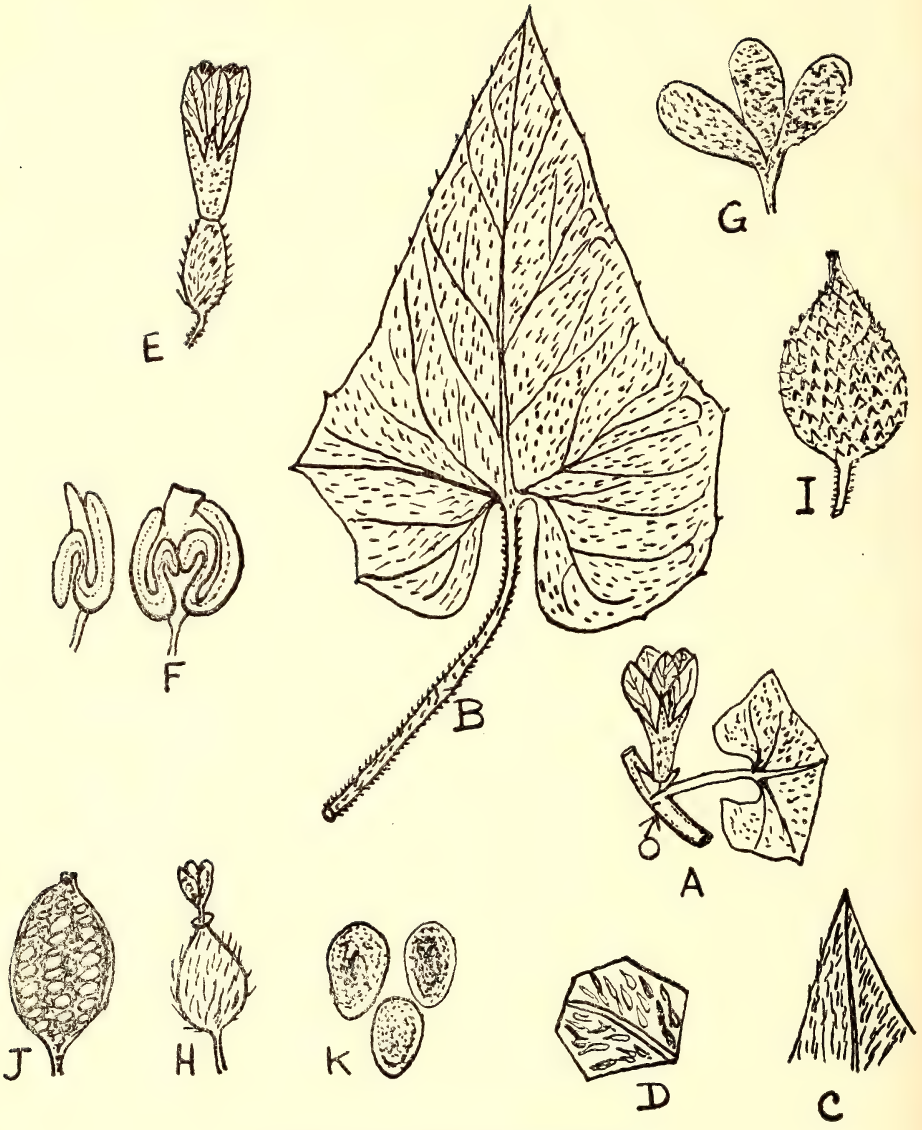
Cucumis muriculatus Chakravarty, sp. nov.

Species haec fructibus muriculatis est valde conspicua; proxima est *Cucumi prophetarum* Linn., a quo caulibus flavido-brunneis, foliis denisus pubescentibus, petiolo gracili haud fragili, fructibus minoribus obovatis nec oblongis vix 1 mm. crassis differt.

Herba monoica scandens. Caulis gracilis, elongatus, sparsim ramosus, angulato-sulcatus, scaber. Foliorum petiolus gracilis dense



Neoluffa sikkimensis Chakr.



Cucumis muriculatus Chakr.

hirsutus, 2·4 cm. longus; lamina utrinque dense atque breviter hirsuta, cordato-ovata, plus minus 3–5-lobata, ad apicem acuminata, margine sparsim serrulato, 5–7 cm. longa et lata; nervi subtus valde prominentes et reticulati; cirrhi simplices, 4–6 cm. longi, breviter villoso-hirsuti. Flores masculi solitarii vel fasciculati; pedunculus brevissimus vel fere obsoletus. Receptaculum cylindricum pubescens 1–6 cm. longum, ± 2 mm. latum. Sepala linearia 1–2 mm. longa. Corolla sparse villosa, 3–5 mm. longa, segmentis ovato-oblongis subacutis. Staminum filamenta filiformia, breviter villosa, ± 1 mm. longa; antherae conduplicatae, fere 2 mm. longae, una unilocularis, ceterae biloculares; appendix connectivi hyalina, glabra, 0·5–0·7 mm. longa. Flores feminei solitarii; pedunculus fere 5 mm. longus; receptaculum et calyx et corolla ut in floribus masculis; corolla 6–10 mm. longa. Ovarium oblongo-ovatum, dense hirsutum. Stylus 2–3 mm. longus. Stigmata carnosa trilobata fere 3 mm. longa et ad medium fere 1 mm. lata. Pedunculus fructifer ± robustus, 0·5–1 cm. longus, rarius ultra 1 cm. Fructus oblongo-globosus, echinato-muriculatus, *Momordicae* fructui fere similis, 2–3 cm. longus, ad medium 1–1·5 cm. latus. Semina plurima, fusca, laevia, ovata, 3–4 mm. longa, ad medium fere 2 mm. lata, fere 0·5 mm. crassa.

This species differs distinctly from its allies in having muriculate *Momordica*-like fruit, densely pubescent leaves and shortly pedunculate flowers and fruits. It has certain similarities with *Cucumis prophetarum* Linn., but differs from it in the following characters:—(i) fruit small echinate-muriculate, (ii) leaves more densely pubescent, (iii) stem yellowish brown and not whitish as in *C. prophetarum*, (iv) petiole slender but not brittle, (v) seeds ovate and not oblong and thickness less than 1 mm.

Burma: Ruby Mines District (J. H. Lace, No. 6315, October 1912. Herb. Edin. Type).

Melothria assamica Chakravarty, sp. nov.

Species affinis *Melothriae maderaspatanae* (L.) Cogn., a qua fructu longius pedunculato, oblongo nec globoso, atque seminibus complanatis, basi haud apiculatis, marginibus prominentibus differt.

Caulis scandens, gracilis, hispidus. Foliorum petiolus gracilis, breviter hispidus, 2–2·5 cm. longus; lamina membranacea, ovato-cordata, 5-lobata, obtusa vel acuta, margine denticulato, utrinque breviter hispida, 2–3 cm. longa, 3–5 cm. lata; sinus basilaris saepius anguste rotundus, 10–15 mm. profundus. Cirrhi simplices, gracillimi, minute hirsuti, 3–4 cm. longi. Flores monoici. Pedunculus communis brevis. Flores masculi et feminei saepius ex dissimilibus axillis orientes vel interdum mixti. Pedicelli masculi 2–3 mm. longi. Receptaculum sparse villoso-hirsutum, basi acutum, 2–2·5 mm. longum, ± 1·5 mm. latum. Sepala erecta, subulata, 1–1·5 mm. longa. Corolla flavescens, extus villoso-hirsuta, segmentis ovato-oblongis, apice ± rotundatis, 2–2·5 mm. longis, ± 1 mm. latis. Stamina 3, inclusa, tubo receptaculi inserta; filamenta breviter pilosa, 0·3–0·5 mm. longa; antherae oblongae, ciliatae, basi hispidae una unilocularis, ceterae biloculares, distincte appendiculatae, ± 1·5 mm. longae. Quoad sepala et petala flores feminei sunt similes. Ovarium oblongum, fusiforme, sparse hirsutum, demum glabrum; stylus 1·2–1·4 mm. longus; stigma tripartitum ± 0·4 mm. longum; styli discus albus, cupuliformis, margine undulatus, ± 0·8 mm. diam. Pedunculus fructifer ± filiformis, 8–15 mm. longus. Fructus oblongus, carnosus, 10–12 mm. longus, 6–8 mm. latus. Semina obovato-oblonga, utrinque scrobiculata, haud apiculata, ± 4·51 mm. longa, ± 2·5 mm. lata, marginibus prominentibus.

Assam: Cachar (R.L. Keenan, June 1874. Herb. Kew Type).

Melothria assamica var. **scabra** Chakravarty, var. nov.

Varietas haec foliis rigidis scabris distinguitur. The variety differs from the type in having scabrid and rigid leaves.

Assam: Goalpara, Chirang Duar Duar (King's collector, No. 1890 Herb. Cal. Type).

Melothria ritchiei Chakravarty, sp. nov.

Affinis *M. zeylanicae* Clarke a qua foliis pentagonis brevioribus hirsutis, floribus laxe fasciculatis, pedicellis florum masculorum minoribus dense villosis, receptaculo longiore quam latiore; fructu breviore lineari haud costato, seminibus minoribus recedit.

Caules graciles, elongati, ramosi, angulati, breviter sparse pilosi. Foliorum petioli graciles, breviter villosi, 4–7 cm. longi; lamina membranacea, cordata, 5-angularis, 2–4 cm. longa et lata vel aliquantum latior quam longa, apice acuta, basi late emarginata, margine ± undulato, denticulato, utrinque intense viridis villoso-hirsuta. Cirrhi simplices, filiformes, breves, subglabri. Flores monoici. Pedunculi

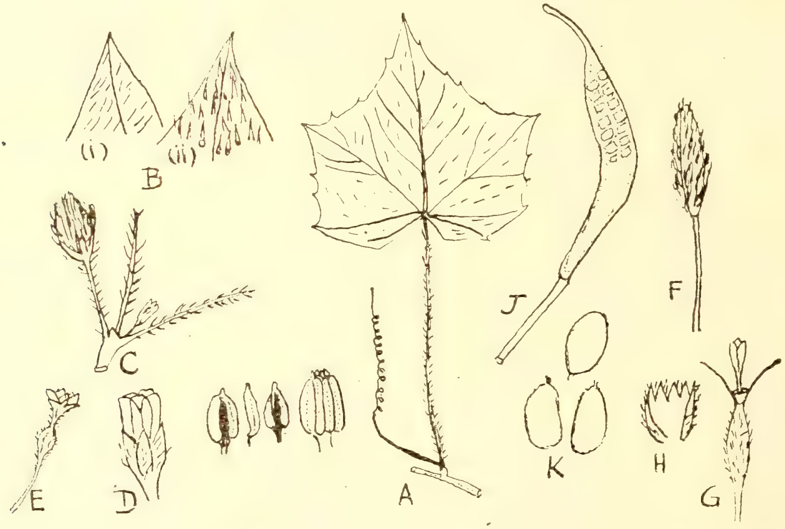


Fig. *Melothria ritchiei* Chakravarty.

A — part of a stem with a leaf and a tendril × 2/3; B — apical portion of a leaf showing hairs on (i) upper surface, (ii) lower surface × 4/3; C — part of the stem with 2 male flower buds *ca.* × 5; D — a male flower *ca.* × 3; E — female flower × 2/3; F — ovary × 4; G — female flower showing ovary, stylar disc and trilobed stigma *ca.* × 5; H — calyx tube split open *ca.* × 5; I — stamens different views *ca.* × 5; J — a fruit × 1; K — seeds *ca.* × 5.

masculi brevissimi, 1–2 mm. longi, floribus paucis pedicellatis fasciculatis; flores superiores saepe caduci; pedicelli filiformes, patuli, dense hirsuti, 2–10 cm. longi. Receptaculum campanulatum breviter et sparse villosum, ± 2 mm. longum et circa 1 mm. latum. Sepala 5, subulata, ± 0·5 mm. longa. Petala fusca, patula, oblongo-ovata, acuta, sparse villosa, ± 3 mm. longa; staminum filamenta glabra, ± 0·5 mm. longa; antherae connatae, una unilocularis, ceterae biloculares, rectae, aliquantum curvatae, circa 1 mm. longa, connectivo latiusculo apice brevissime producto. Flores feminei solitarii vel pauci masculis similes; pedunculi 4–5 mm. longi. Ovarium elongato-lineare; stylus brevis, disco cupuliformi albo, stigmate 3-lobato. Fructus elongato-linearis fuscus, rostratus, apice basique attenuatus sparse hirsutus, fere glaber. Semina pauca fusca, ovato-oblonga, haud marginata, 2–3 mm. longa, circa 1 mm. lata.

Peninsular India: Bombay Presidency, Savantvadi State, Ram Ghat (*Ritchie*, No. 67 Herb, Edin. Type); in grass on a hill near Devarayi, 1,800 ft. M.S.M. Ry. (*Sedgwick* and *Bell*, No. 4103, July 1918, Herb. Cal.); moist, clefts of rocks on hillside, Pullival Ridges, Kanan Devan Hills, Devicolam Taluk, N. Travancore (*Sinclair*, No 3589, 1st July 1944, Herb. Edin.).

This species is allied to *Melothria zeylanica* Clarke but can be distinguished from it by (i) shorter angular leaves with long petioles, (ii) flowers in lax fascicles, (iii) smaller male pedicels, (iv) receptacle longer than broad, (v) fruit shorter, linear, not ribbed, (vi) seeds smaller.

Melothria angulata Chakravarty, sp. nov.

Species haec est affinis *M. heterophyllae* (Lour.) Cogn. a qua fructo 9-angulato, seminibus late marginatis valde rugosis differt.

Dioica. Caulis scandens. Rami graciles, elongati, sulcati, glabri. Foliorum petiolus, 0·5–1 cm. longus, brevissime villosus, lamina 6–20 cm. longa, coriacea, rigidiuscula, polymorpha, plerumque hastata vel sagittata, margine minute atque remote denticulato vel interdum fere integerrimo, supra squamis scabro-punctata, pallide viridis in sicco, subtus pallidior, squamosa, glandulis paucis ad basim notata. Cirrhi graciles, longissimi, glabri. Flores masculi subumbellati; pedunculus communis gracilis, apice 7–25–florus, 0·5–5 mm. longus; pedicelli erecto-patuli filiformes, fere glabri, 2–8 mm. longi. Receptaculum campanulato-subcylindricum, basi rotundum, glabrum, ± 5 mm, longum, ± 3 mm. latum. Sepala subulata, 0·2–0·3 mm. longa. Corolla flavescens, brevissime puberula, segmentis patulis triangularibus acutis ± 1·5 mm. longis. Stamina 3; filamenta gracillima, glabra, ± 3 mm. longa; antherae suborbiculares. Flores feminei solitarii; pedunculus 0·5–1 cm. longus. Ovarium angulatum, glabrum. Fructus in sicco flavescenti-ruber, obtuse 9-angulatus, polyspermus, 4–7 cm. longus, 2–2·5 cm. latus; semina oblonga, turgida, valde marginata, balteo distincto munita, 7–7·5 mm. longa, 5–5·5 mm. lata, 3–3·5 mm. crassa.

S. India: Gomata (Malcolmpeth, No. 81 Herb. Cal. Type); Perumal 5,500 ft. (Sauliére, Nos. 70, 71 Herb. Cal.).

This species is close to *M. heterophylla* (Lour.) Cogn. in many respects, but can be easily distinguished by its 9-angular fruits and strongly margined rugose seeds.

Sheet No. 1398 Herb. Cal., collected by M. S. Ramaswami from Velligonda Hills (Block B), District Nellore, seems to be a variety(?) of *M. angulata.* The fruit is somewhat smaller and leaf-punctations minuter. Till further materials are available it is provisionally kept under the type.

Gynostemma burmanica King ex Chakravarty, *Ind. Journ. Agric. Sc.* XVI. 1 (1946) 85.

A rather stout climber. Stem pubescent more so on the tender parts. Leaves trifoliate, petiole shortly and densely rusty pubescent, sulcate, 3·5–4·5. cm. long; petiolules 3–4 mm. long; lamina rusty tomentose on both surfaces denser on the veins of lower surface: middle leaflet lanceolate attenuate at base apex acute or slightly acuminate, margin crenulate-dentate, 6–8 cm. long, 3–4 cm. broad; lateral leaflets somewhat shorter and oblique at base. Tendril simple elongate, sulcate, glabrous. Male peduncles slender, pubescent 10–30 cm. long or still longer; pedicels capillary 1–2 mm. long, at base bracteolate; bracteoles subulate about 1 mm. long. Calyx segments acute about 1–1·5 mm. long. Petals one nerved 1–2 mm. long. Stamens 5, minute, about ·5 mm. long. Female flowers and fruits not seen.

Burma: Upper Burma, Maymyo (*Badal Khan*, No. 153 Herb. Cal.); S. Shan States, Toungyi (*Abdul Khalil*, Herb. Cal.);

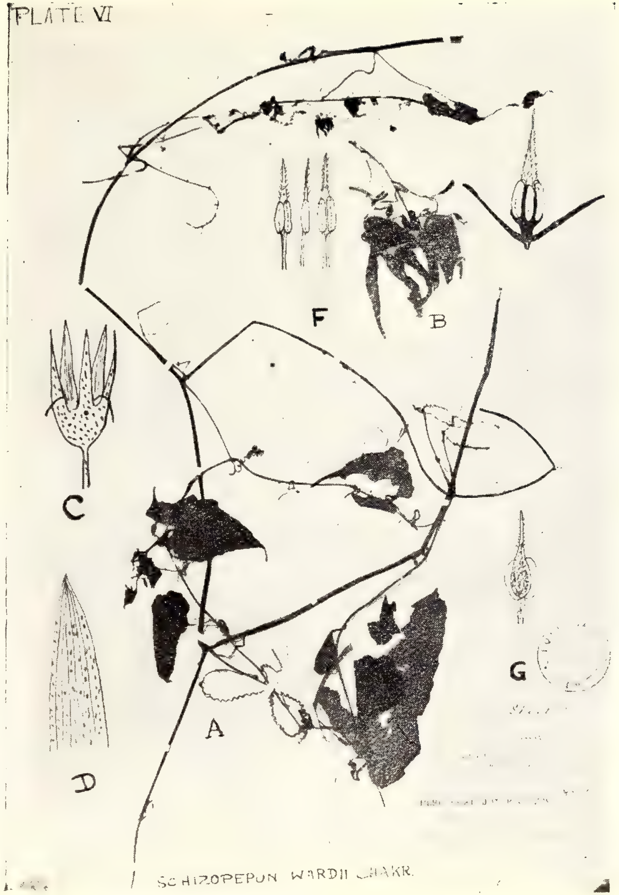
Thamakhan (*Abdul Khalil*, Herb. Cal.).

Schizopepon wardii Chakravarty, sp. nov.

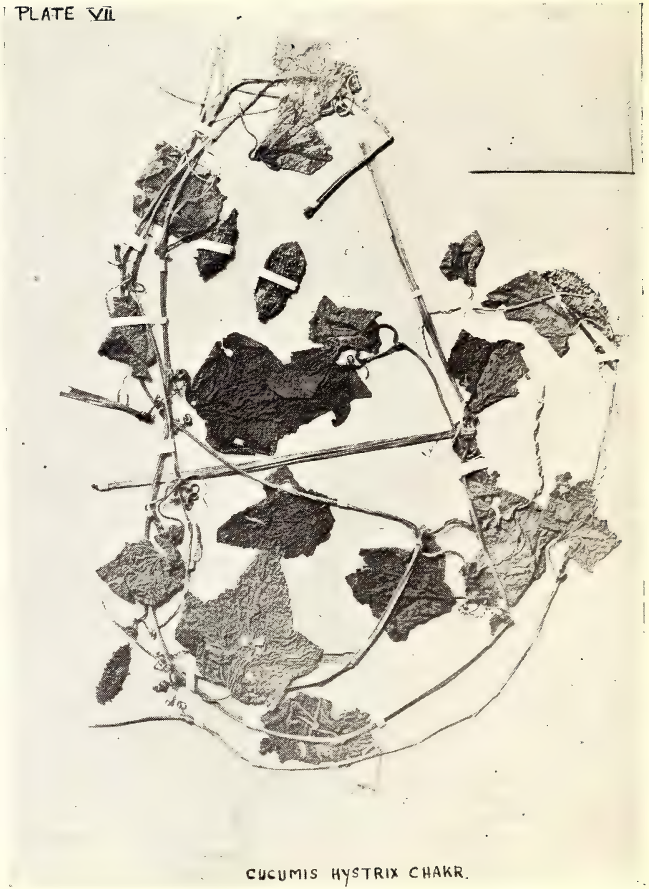
Species affinis *Schizopeponi macrantho* Haud.-Mzt. a quo lamina haud lobata, pedicellis longioribus, connectivo conico ultra loculum producto differt.

Caulis scandens, gracilis, debilis, ramosus, sulcatus, glaber. Foliorum petiolus gracilis, sulcatus, glaber vel breviter villosus, 2–4·5 cm. longus; lamina membranecea, ovato-cordata, undulata vel aliquantum angulata, 7–8·5 cm. longa, 4–5 cm. ad basim lata, acuminata, remote mucronulato-denticulata, supra breviter et sparse hirsuto-scabra, subtus glabra nisi ad nervos minute et remote hirsuta; nervi palmato-pedati. Cirrhi plus minusve graciles, 2-vel 3-fidi, glabri. Flores dioici (♀ ignoti) in racemis axillaribus solitariis. Racemi masculi, 4–7 cm. longi, 8–15-flori, ebracteati; pedicelli patuli, filiformes, 7–12 mm. longi. Receptaculum late campanulatum 5-6 mm. profundum, intus minute glanduloso-papillosum. Sepala linearia, lanceolato-subulata, 2–2·5 mm. longa, 0·3–0·4 mm. lata. Corolla subrotata, flavida, utrinque sparsim glanduloso papillosa; petala 6-nervia, linearia-lanceolata, 7–9 mm. longa, 1–2 mm. lata, acuta. Stamina 3, monadelpha, inclusa; filamenta ad receptaculi basim inserta, plus minusve 1 mm. longa, glabra; antherae 3–3·5 mm. longae (connectivo incluso), connatae, una unilocularis, ceterae biloculares; loculi erecti; connectivum lineare conicum, productum, minute papillosum, 1·5–2 mm. longum.

Assam: Delei Valley 11,000 ft. 28° 15′ N. 96° 35′ E. in Rhododendron-Conifer Forest, open gullies facing north (*F. Kingdom Ward*, No. 8567 Herb. Kew. Type, 23. 8. 1928).



(A) *Schizopepon wardii* Chakr.



(B) *Cucumis hystrix* Chakr.

The species has affinity towards *S. macranthus* Haud.-Mzt., but differs in the following characters: (i) leaves not lobed, (ii) pedicels longer and (iii) connective produced beyond the loculus.

In conclusion I offer my sincerest thanks to my Professor Sir Willam Wright Smith, F.R.S., for his untiring help and encouragement during the preparation of this work.

EXPLANATION OF PLATES

I. *Trichosanthes tomentosa* Chakravarty. A — a part of the stem with a flower and a simple tendril × 1; B — a portion of the stem showing 4-lobed tendril × 1; C — a portion of the upper surface of the leaf showing tomenta and glands × 2; D — a female flower × 1; E — a female flower showing style and trilobed stigma × 2.

II. *Trichosanthes listeri* Chakravarty. A — a portion of the stem; B — a flower bud *ca.* × 4/3; C — a flower *ca.* × 1; D — a part of the calyx tube split open to show the stamens *ca.* × 4/3.

III. *Neoluffa sikkimensis* Chakravarty. A — a portion of the stem with inflorescence *ca.* × 1/3; B — a part of the leaf *ca.* × 3/2; C — a bract; D & E — flower buds *ca.* × 4 and 5; F — back view of flower *ca.* × 1; G — dorsal view of the calyx tube of a male flower *ca.* × 1; H — front view of a flower, petals 5; stamens 2 + 2 + 1 *ca.* × 1; I — a part of the flower showing a petal and two stamens *ca.* × 5; J — male flower, perianth removed showing stamens; K & L — anther with loculus, front view *ca.* × 5; M, N, O — anthers showing granular connective.

IV. *Cucumis muriculatus* Chakravarty. A — part of the stem with a male flower × 1; B — a leaf × 1; C, D — part of the upper and lower surfaces of a leaf showing hairs × 8; E — a female flower × 1; F — a simple and a compound stamen showing connective appendages and anther loculi × 8; G — trilobed stigma × 5; H — ovary with style and stigma × 1; I — a fruit × 1; J — L.S. of a fruit × 1.

V. (A). *Schizopepon wardii* Chakravarty. A — general appearance *ca.* × 1/4; B — part of the stem showing two male flowers *ca.* × 3/2; C — a male flower *ca.* × 3/4; D — a part of the papillose petal *ca.* × 5/2; E — a flower dissected to show manadelphous stamens and coneshaped papillose appendage *ca.* × 2; F — stamens with appendage, one 1-locular, two bi-locular *ca.* × 2; G — dorsal view of the single bi-locular stamen *ca.* × 5/2.

V. (B). *Cucumis hystrix* Chakravarty. *ca.* × 1/4.

VANISHING AND EXTINCT BIRD SPECIES OF INDIA

BY

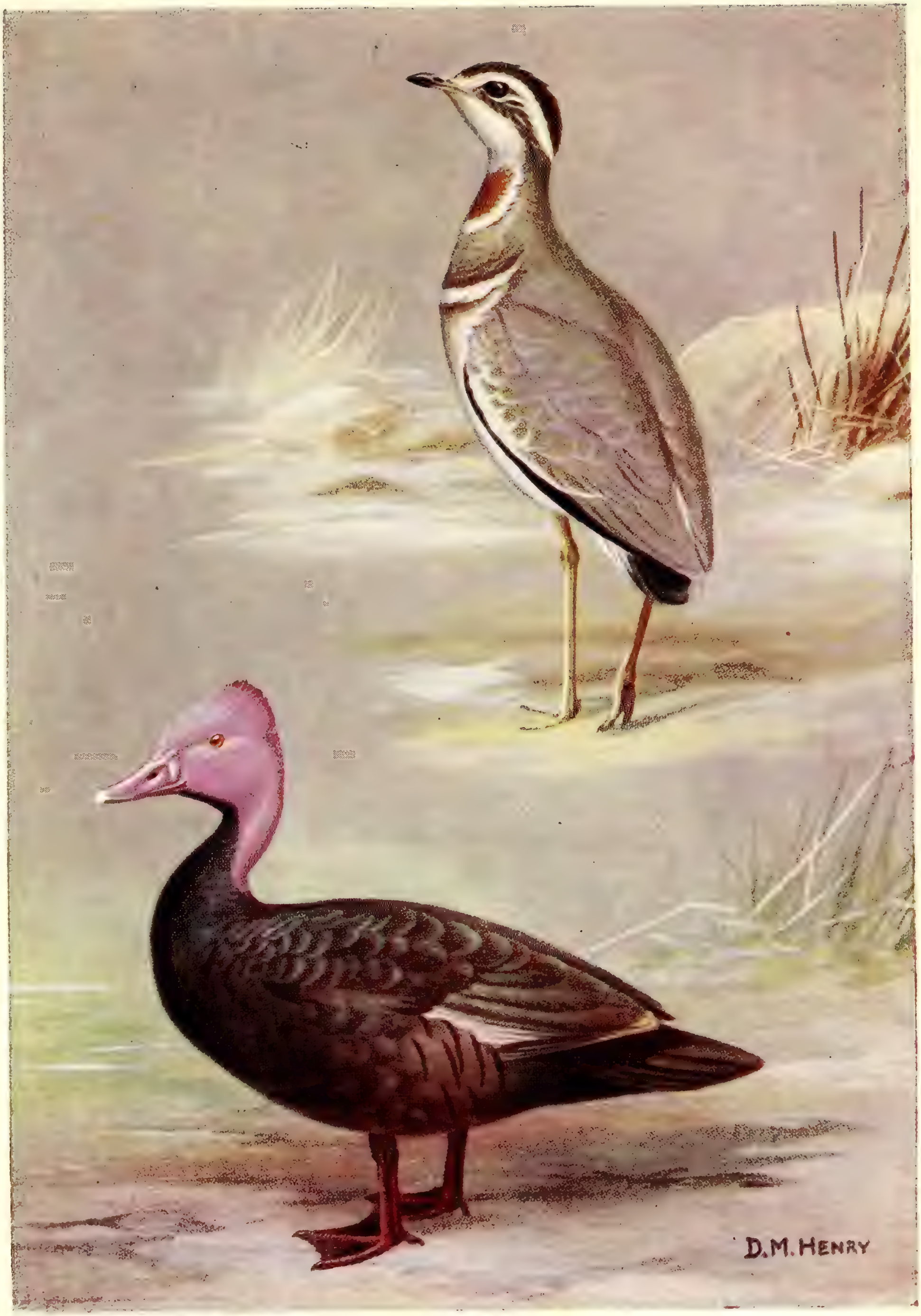
S. DILLON RIPLEY

(*With two coloured plates*)

Human history is full of memorials both to its greatness and to its powers of destruction. On the negative side of our historical ledger many sad records are listed of waste, neglect, and wanton abuse of our natural heritage. Human beings tend to have the presumptuous feeling that the world and all its marvellous works are their 'oyster'—their own personal inheritance. This careless waste of the gifts of nature extends to species of living animals and birds as well as to the forests and to the soil on which we depend for our very existence. Recently two interesting books have been published on man's ability to destroy his natural environment, and on the great need for conservation of our dwindling resources. These books, *Our Plundered Planet* by Fairfield Osborn, and *Road to Survival* by William Vogt, paint a dreary picture of human thoughtlessness, and point up the tremendous, really strategic need for conservation of our soils and water tables, on which, far more than the atomic bomb, the future of the human race depends.

The aesthetic and cultural side of conservation is of great importance to our race as well. There is a responsibility to the future vested in all of us to protect and preserve vanishing species. Indeed a Buddhist might well argue that we could store up merit for the future of our own race by attempting to preserve the races of the animal kingdom.

Among the birds of India, there are four species which are either now extinct, or so seriously threatened that their future is highly problematical. What has caused these species to become so sadly depleted is not entirely clear. Two facts at least stand out. One is that all four species are large birds, of game-bird status, and have undoubtedly been the target of sportsmen with guns, snares or other fowling devices for many generations. Another parallel fact is that three of the species are birds of the Ganges basin or Peninsular India so that their movements as large, conspicuous birds have become increasingly circumscribed by the destruction of jungle and open parkland which must have been their favored habitat, and the gradual transformation into closely held agricultural land. There is a further fact which probably has biological significance, but which is now not sufficiently understood by students of ecology or animal distribution. The three species found in the Gangetic basin or Peninsular India now or in former times are all what might be termed 'relict' species; forms whose near relatives are widely dispersed, in the African or European regions. These species have become isolated from their close relatives, possibly during the earliest Tertiary times when the disappearance of the Sea of Tethys and the mountain



Jerdon's Courser, *Rhinoptilus bitorquatus* Blyth
Pinkheaded Duck, *Rhodonessa caryophyllacea* (Latham), male

building developments in northern India and central Asia must have caused vast changes with alternate bridging and isolation of the peninsular area of the Indian subcontinent. However, perhaps we need not look so far back in the case of some of these species, for their relationship to the present fauna of Africa seems close enough to postulate that they are the end remnants of a former continuous distribution from Africa across Arabia and Mesopotamia dating back to the pluvial epochs of Recent times, which, parallelling the glacial periods extended a vegetation belt across the intervening area.

Whatever the cause of the disappearance of these species, every effort should now be bent by conservation-minded citizens to protect and preserve the remnant population that may still exist. It is the duty of all who are interested in this subject and informed upon it, to disseminate their interest and information to others, and to attempt to find out any further relevant facts about the existence and the possible protection of these forlorn and lovely birds.

Rhodonessa caryophyllacea (Latham): Pinkheaded Duck.
Hindi: *Gulab Sir.*

This beautiful and curious bird once had a range which extended as far north as Punjab and U.P., as far south as Madras, and east to Assam and Burma. No certain record of its existence has come to light since the mid-nineteen thirties. The last reliable record I know of is June 1935 in Darbhanga District, Bihar (C. M. Inglis). I say reliable because the resemblance between this species and the Redcrested Pochard (*Netta rufina*) is great enough to make casual identification difficult. A key to the more obvious differences between the two species might be as follows:

	Head	*Upper Surface*	*Underparts*	*Outer edge of Secondaries*
♂ Pinkhead	pink	dark brown	dark brown	light buff
♂ Redcrest	reddish with golden-orange area on top	light brown, white patch on shoulders	black, white flanks	creamy-white
♀ Pinkhead	palish, pink only on top	dull brown	dull brown	pale brownish-buff
♀ Redcrest	grayish-brown, crown dark brown	dull brown	grayish ochre to whitish	gray

Both species have bright pinkish or reddish bills in the male. Both species are much the same in size, although the Pinkhead would never weigh over two and a half pounds, and both are likely to be isolated from the main flocks of migratory duck, although the Redcrested Pochard being a diving duck is somewhat more likely to be in areas of large open water.

No recent record of the shooting of a Pinkheaded Duck by a sportsman, presumably we hope by accident, should be credited unless accompanied by a recognizable specimen, or at least the head and bill, preserved for study in a museum such as the Prince of Wales Museum at Bombay or the Indian Museum at Calcutta.

The spate of correspondence about the occurrence of the Pinkheaded Duck during July, August, and September 1950 in the daily *Statesman* of Calcutta appear to refer, as far as recent records are concerned, to the Redcrested Pochard, even though these records came from the very area where one should be on the lookout for this long-lost and beautiful species. This area consists of southern Bihar and northern Orissa. The area near the Sankh River would seem to be a natural winter home for the species as well as in northern Bihar, in Darbhanga where the last records have occurred. There is no recent information of the occurrence of the species at all in eastern Assam, Manipur, and northwestern Burma, where the untouched state of the forest and remote 'jheels' or 'bhils' might be such as to favor the continued existence of the species, which by nature is a forest-pool inhabitant. I have been told that the last trapped specimens secured by the late Sir David Ezra in the thirties and kept in captivity for some time, came from southern Goalpara and eastern Rangpur, near the confluence of the Tista and the Brahmaputra Rivers, but there has been no subsequent trapping or information to bear out the further occurrence of these birds.

As to relationship, there has been much speculation about the Pinkheaded Duck. The most ornithologists can contrive to say about it is that it is an 'aberrant' species without close relatives. In the past it has been considered related to the perching ducks such as the Comb-duck or 'Nukhta'. The egg is said to be rather rounded (Mr. Inglis has one in his collection[1]), and reports have been made that the ducks have been seen to perch in trees. On the other hand in colour pattern, and reduced display and behaviour postures, it resembled distantly the Redcrested Pochard, which some authors have likened to a link between the river ducks and the diving ducks. Perhaps the Pinkhead, an old isolated 'relict' species, points back to some such transitional generalized form of duck—an ancestral stock which evolved eventually into the two main streams of evolution of the river and diving ducks, the Mallard-like forms and the Pochard-like forms.

Ophrysia superciliosa (Gray): Mountain Quail.

No more is known about the occurrence of this small quail to-day than many years ago. All the five specimens in the British Museum came from Mussoorie and Naini Tal at altitudes from 5,000 to 6,000

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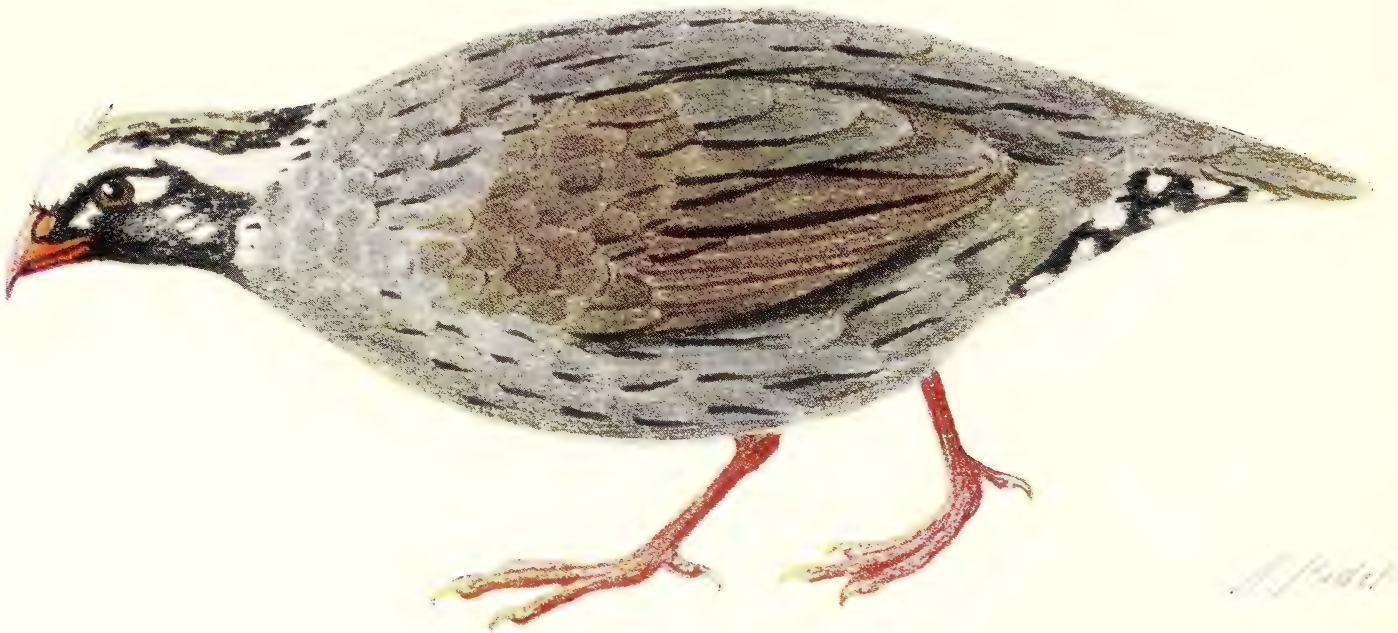
[1] Laid in captivity; measuring 47×43 mm.—Eds.



The Mountain Quail, *Ophrysia superciliosa* (Gray), male

feet. The bird, which has been classified as a small partridge, related on the one hand to the Blood-pheasants (*Ithaginis*) and on the other to the Spurfowl (*Galloperdix*) is an inhabitant of very long grass, and apparently is primarily a runner, not a flyer. It would be virtually impossible to secure a specimen without a capable dog. During my visit in west Nepal I attempted to gain any information that I could about this species, but no news was forthcoming. I was told that the species was known in the Dailekh District, and that its local name was 'sano kalo titra', a purely descriptive name indeed.

Recently reports have come that a specimen has been shot in East Kumaon during the last five years, not far from a village called Lohaghat. Unfortunately attempts to corroborate this did not meet with success, so that at present we are as much in the dark as ever about the fate of the Mountain Quail[1].

Choriotis nigriceps (Vigors) : Great Indian Bustard.

Once found from the Punjab and Sind right across to southern Madras, this great bustard, relative of several African and one Australian species, seems doomed to extinction. Isolated pairs may still linger in Rajasthan, perhaps in Gwalior, in Berar and Hyderabad. No specimens have been recorded from Hyderabad since 1924, or from Madras (near Trichinopoly) since the same year. At least no other specimens have been recorded for science. This magnificent bird, standing nearly four feet high and weighing at least over 10 pounds, is of all India's vanishing species the one most needing protection, as it is a mark for the hunter or sportsman of almost irresistible attraction. It is to be hoped that Government will take pains to publicize the need to protect this rare and magnificent bird[2].

Rhinoptilus bitorquatus Blyth: Jerdon's Courser.

This courser is a close relative of a group of coursers now found in Africa. No new information has come to light since the original specimens were taken in 1871, although it has been recorded from several localities. It apparently frequented light forested areas, in contrast to its more open plain-loving relatives in Africa, and has been seen on both sides of the Godavary River near Borgampad in Hyderabad, and in Madras, Cuddapah and Nellore. Not man, but some environmental factor must have been responsible for the disappearance of this fine bird[1].

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[1] A full description of the bird and all the meagre information we possess concerning it will be found on pp. 22-24 of Vol XXVII of the *Journal*, in the serial 'The Game Birds of India, Burma and Ceylon' by E. C. Stuart Baker.—Eds.

[2] For a coloured plate and full description of habits and former status, see *Journal B.N.H.S.*, Vol. XXI, pp. 304-324 (under *Eupodotis edwardsi*, by E. C. Stuart Baker).

Although persecution has squeezed the Great Indian Bustard alarmingly close to the edge of extinction, happily enough it can not as yet be placed in the same category of rarity or near-extinction as the other three species mentioned in this article. There is still hope for its continued existence provided no more time is lost in initiating and enforcing suitable protective measures. That no recent published records of its occurrence exist from areas of its former abundance is not in itself of great significance since the species has *as yet* not become rare enough to warrant the publication of every individual specimen shot. However, there is certainly no room at all for complacency.—Eds.

There are other rare birds in India to-day. No one has any recent information on *Athene blewitti*, the Forest Spotted Owlet, known only from near Sambalpur and Karial. However, the fact that no new information has come to light about this species since 1872, is not evidence that the owlet is extinct. The forests of central India have fortunately not yet disappeared, and cover a large area. It is not unusual among shy or skulking bird species for information about them to be lacking for a generation or more. They lead their own lives, unknown to the eyes and ears of humankind. But the larger species, such as the ducks, pheasants, and other game birds, and especially the Great Bustard are prey for everyone, and much needs to be done to protect them from the permanent fate of extinction.

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[1] For another coloured plate, description, habits and history etc., see *Jour. B.N.H.S.* Vol. XXXIV, pp. 5-6 (Stuart Baker).—Eds.

THE HISTORY OF HERPETOLOGY IN INDIA

BY

MALCOLM A. SMITH, M.R.C.S., L.R.C.P. (London)

The history of herpetology in India begins at the end of the eighteenth century, when Patrick Russell and Thomas Hardwicke came to the country in the service of the East India Company. They lived and worked independently, but they were contemporaries and they may be considered together. Dr. Russell's life in India began in 1781 when at the age of 55, after some 20 years in the near East, he joined his younger brother who was returning to India, and lived at Vizagapatam in the Madras Presidency. Four years later he was appointed botanist and naturalist to the East India Company and for the remainder of his stay in the country was indefatigable in his researches, not only in botany, but in collecting, figuring and describing the fishes and snakes of the country. He was particularly interested in the poisonous snakes. He was the first person in India to distinguish the harmless from the poisonous species and his treatise, 'On the Peculiar Organs in the Mouth of Poisonous Snakes' illustrated with figures was published by the Government of India in 1787 and circulated in the settlements and military stations. He experimented widely with the common species of poisonous snakes making them bite animals and birds so that he could observe the symptoms, discover the varying degrees of toxicity and with that knowledge devise treatment to save human life. Nothing very novel, however, resulted from his experiments which were based largely upon an already reputed remedy known as the Tanjore Pill, a combination of mercury, arsenic, pepper and the extracts of certain herbs. His two volumes 'An account of Indian Serpents collected on the coast of Coromandel' and 'A continuation of an account of Indian Serpents' containing brief descriptions and carefully executed colour plates were published in 1786 and 1801 to 1809 respectively. Only the vernacular names of the snakes are given. A good account of Russell's life, with a portrait, is in the second volume of this work which was not completed until after his death.

Major-General Thomas Hardwicke spent his life in India in the army. As a young man of 21 he landed in the country in 1778 and there he spent the next 25 years. Hardwicke was an assiduous collector, not only of specimens in all branches of natural history but also of drawings and water-colour sketches of plants and animals. Most of these were drawn by native artists whom he employed for the purpose. The total number of his sketches fill 32 volumes and are now in the British Museum (Natural History). Two of the volumes contain the sketches of the reptiles (mainly snakes) and amphibians. Hardwicke did not contribute anything to the literature of herpetology, but his sketches and preserved specimens were used extensively by the systematists of his time and in that way our knowledge of the herpetology of India was enriched.

Other names connected with the early history of herpetology in India are Francis Buchanan-Hamilton, also a collector of water-colour sketches, Brian Hodgson who spent his life chiefly in Nepal, James Emerson Tennant, whose book the 'Natural History of Ceylon' was the first to deal with the natural history of the Island, Edward Blyth, the first curator of the Museum of the Asiatic Society of Bengal, Dr W. T. Blanford who, in his work on the geological survey of India, travelled and collected widely, and Col. R. H. Beddome to whom herpetology is indebted in particular for our knowledge of the Uropelts.

With the arrival of Dr. J. Fayrer in India a new era in the study of ophiology commenced. Fayrer devoted himself particularly to the poisonous snakes and his 'Thanatophidia of India' published in 1874 was a notable contribution. He made a careful study of the poison apparatus. By experimenting with animals and birds which he caused to be bitten by snakes, by a study of the symptoms of those people who had been bitten and brought to him for treatment he greatly advanced our knowledge of snake bite. He was the first to recognize that the venom of the elapine snakes was different in its effects upon the body from that of the viperine species. He made many advances in treatment. He advocated ligature and incision of the wound, suction under certain conditions, and destruction of the tissues at the seat of injury both by caustics and by the cautery. He tried amputation when it was possible. He was the originator of the treatment by potassium permanganate.

In 1860 the entire collection of preserved specimens of reptiles in the possession of the East India Company was presented to the British Museum and it was the arrival of this valuable material in England that led Dr. Albert Günther to compile his volume 'The Reptiles of British India'. This was published by the Ray Society in 1864. It was the first complete monograph to deal with the herpetology of the country. Dr. Günther never visited India and had no knowledge of the animals in the wild state. Nevertheless his volume was a valuable contribution to the subject and was for many years the standard work of reference. The volume is well illustrated, the source of many of the pictures being the collection of drawings made by Sir Walter Elliot during his long residence in the Madras Presidency.

Other workers of note on herpetology at the latter end of the last century and the beginning of the present one are Dr. John Anderson who made two expeditions to Yunnan, Lt.-Col. Henry Godwin-Austen who spent most of his service in India in Assam, Ferdinand Stoliczka who travelled extensively in the Himalayas and was the first naturalist to study the natural history of the Andaman and Nicobar Islands, and Harold Ferguson who enriched our knowledge in particular of the district of Travancore.

Above all others, however, stands George Albert Boulenger, not only for his 'Reptilia and Batrachia' in the Fauna of British India series, but for the very large number of papers and articles on herpetological subjects which he wrote at that time. Like Günther, Boulenger never visited India and his work was mainly on systematics. But the classification adopted by him in his treatment of the subject was a great advance on that of his predecessors and his major arrangement of the families has not been disputed since. For 40 years his volume remained the standard work on the subject.

To Colonel Frank Wall we are indebted more than any other man for our knowledge of the habits of the Indian snakes. As a member of the Indian Medical Service he arrived in the country in 1894. There he was to spend most of the next 30 years of his life and in the course of his duties was stationed in most parts of the Peninsula including Ceylon and Burma. Wherever Wall went he collected and studied his material, and by his enthusiasm induced others to collect for him. He was not a museum worker. His interest was in the living creatures and his voluminous writings deal almost entirely with their habits and structure. His larger works include 'The Snakes of Ceylon', 'The Poisonous Snakes of our British Indian Dominions' and 'A Popular Treatise on the Common Indian Snakes'.

The writer's contribution to Indian herpetology is the three volumes on the reptiles in the Fauna of British India series published during 1931–1943. The classification adopted is with some small alterations that used by Boulenger, but in addition to the descriptions given, an attempt has been made to include an account of the life histories of those species that are known. It is unfortunate that the volume on the snakes is now out of print, all the unbound copies of the book having been destroyed by fire during one of the air raids on London. The volume on the amphibia is not yet written.

In recent years an intensive study of the reptiles of Ceylon has been made by Dr. P. E. P. Deraniyagala. He has devoted himself specially to the Chelonians, and his volume 'Tetrapod Reptiles of Ceylon' published in 1939 covers the group very completely. His account of the development of the species is an aspect of the subject that has not been undertaken before. In his introduction to the volume Dr. Deraniyagala has given also a brief account of the chief workers on herpetology connected with the Island. It is impossible, in a brief survey of the history of herpetology of India, such as has been attempted here, to mention every one who has contributed to the subject. Notes and short articles on habits, structure and distribution dealing with individual species are constantly appearing, the majority of them in the pages of this journal.

OBITUARIES

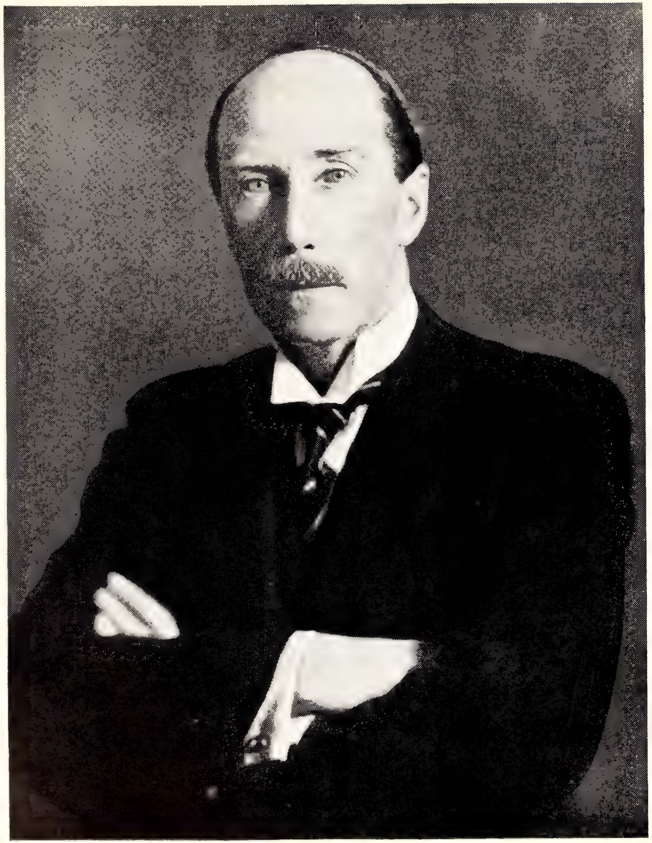
W. S. MILLARD

(*Plate*)

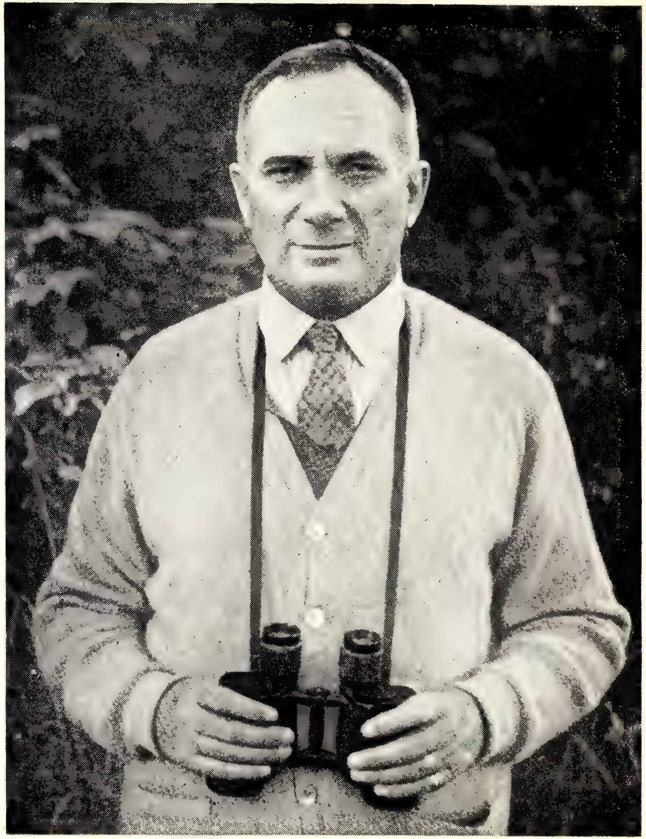
By the death of W. S. Millard at Tunbridge Wells on March 24 the Society has lost not only its oldest member, but the last link with the original founders.

Walter Samuel Millard, the seventh son of the Rev. J. H. Millard was born at Hungtingdon in 1864. After working for some time with Messrs. Frank Bailey & Co., wine importers in London he went to Bombay in 1884 as assistant to Herbert Phipson, who some years previously had started a wine business in that city. Phipson was a very remarkable man with a great interest in natural history, and though not one of the original founders, had been the mainstay of the Society from its beginning. Since 1886 he had held the offices of Honorary Secretary and editor of the *Journal,* and moreover had accommodated the Society in his original office in Forbes Street. But by the time Millard arrived he had moved to more commodious quarters at 6 (now 114), Apollo Street, the residence in former times of the Chief Justice of Bombay, and rented to the Society several rooms. It was impossible to work with Phipson without becoming interested in natural history. To reach his office it was necessary to pass through the Society's museum which, in addition to various stuffed animals and jars containing fish and reptiles, generally housed a live cobra or two and a large python. Not long after his arrival Millard joined the Society, and in 1893 was made assistant editor of the *Journal* though he had doubtless been helping Phipson with the work of the Society for some time previous.

In 1906 Phipson retired from business and Millard was elected to fill his place in the Society. He continued to give it of his best till he left India in 1920. Under the editorship of Phipson and Millard the *Journal* had become the most important scientific publication east of Suez. By the time Millard took over, other scientific journals had sprung up all over the East but the Society's journal remained unique since it not only published important scientific papers but also natural history articles of more general interest, suitable for the majority of members. It was at this time also that the Society began to publish in book form serial articles from its journal, and the first thus to appear was Major Wall's small guide to poisonous snakes which, before long, was in every dispensary from the Bolan Pass to the Chinese frontier. The greatest success in this line was the 'Duck Book' containing Stuart Baker's papers on 'Indian Ducks and their Allies' started as long ago as 1897. Millard took a great pride in this book, and when at home on leave personally saw to the printing and binding so that the volume would be a credit to the Society. He did not, however, realize what a demand there would be for the book and it was in no time out of print. To fill the place of the articles on ducks, Millard persuaded Stuart Baker to write a



Walter S. Millard



Ernest H. N. Lowther

new series on snipe, bustards, sandgrouse and other game birds which in due course were published in two volumes but were never as popular as the first venture. Though Millard took interest in natural history generally, his particular hobby was gardening especially the cultivation of flowering trees and shrubs. A tree, moreover, did not necessarily have to have a beautiful flower to interest him, and it was at his suggestion that Father Blatter wrote the articles on 'The Palms of India'. This was followed a few years later by a series on 'Beautiful Indian Trees' of which Millard and Blatter were the joint authors. For many years Millard had been collecting paintings of flowering trees from all over India and studying the best ways of propagating and growing them. The title of this series was slightly misleading since a number of the trees were not Indian but had been introduced either by Millard himself or by his friend H. V. Kemball of the Improvement Trust.

Among the trees introduced in Bombay by Millard the Burmese *Cassia renigera* is the most outstanding, and indeed it vies with *Amherstia nobilis* as the most beautiful flowering tree in the city. Other introductions include *Pterocarpus indicus* with yellow fragrant flowers, which in spite of its name is also a native of Burma, and *Gliricidia maculata* a delightful South American tree raised from seed sent from Ceylon which first flowered in Millard's garden in 1916.

After Millard married he lived in a bungalow in Winter Road, Malabar Hill, and about 1910 moved to another on 'The Ridge' with much more ground which was soon developed into a beautiful garden with trees and shrubs and a large fernery full of foliage plants, orchids and other tropical flowers. This was the most important private garden in Bombay, and guests staying at Government house were frequently sent to inspect its treasures. On several occasions different governors sought Millard's advice in regard to improving the grounds of Malabar Point, and at Lord Willingdon's request he undertook to supervise the laying out of the grounds at the Willingdon Club.

The study of birds has always been the most popular branch of natural history among members of the Society, but there had been little advance in the knowledge of mammals, other than the big game animals, since Blanford wrote his volume in 1888. R. C. Wroughton, after he retired from the Indian Forest Service took up the study of mammals at the British museum and was continually writing to Millard about this lamentable state of affairs and urging the Society to employ a collector to collect small mammals. Millard, however, could only point out that no collector was available in India and that the finances of the Society did not permit of employing one.

Then one morning in 1910 C. A. Crump suddenly walked into the office. He had just arrived from England and offered his services as a collector or taxidermist. Here was a chance not to be missed, and Millard hastily calling a committee meeting persuaded the members to agree to employ Crump for several months and at the same time to launch an appeal for a Mammal Survey Fund. This appeal was so successful that within a year four collectors were at work and the Mammal Survey firmly established. The collections provided adequate material on which to base the two new volumes of the 'Fauna' by R. I. Pocock, as well as other important publications.

The starting and the success of the Mammal Survey was entirely due to Millard, and only those who were in close association with him at the time have any idea of the amount of time and work he spent in the raising of the money and organising of the survey. All this was done in addition to attending to the Society's other business and editing the *Journal*, to say nothing of looking after his own business of Messrs. Phipson & Co.

Millard's honorary work was not entirely confined to the offices he held in the Society. He was also Secretary of the Countess of Dufferin Fund and the Cama & Albless Hospital, and entirely responsible for the running of the Peachy-Phipson Sanatorium at Nasik. When Phipson left India Millard took his place on the Committee of the Prince of Wales Museum, but in spite of all his efforts the building was not completed till after the outbreak of the 1914 war, when it was turned into a hospital for Indian soldiers, and by the time he left India the building had not yet reverted to the original purpose for which it was built.

It is difficult in a few words to tell of all Millard's activities on behalf of the Society, how he pressed the Government to enquire into the inshore fisheries and indeed if it had not been for the first world war he would have taken up the whole question of the fishing industry in Bombay with the Government. Through his efforts a close time was established for certain birds, while other species were given additional protection. When he finally left Bombay he became the Society's representative in London and undertook the arrangements for the reproduction of plates, printing of books, etc.

Every visitor to the Society's room in Apollo Street will remember the great Indian Hornbill, better known as the 'office canary' which lived in a cage behind Millard's chair in Phipson & Co.'s office for 26 years and died in 1920. It is said its death was caused by swallowing a piece of wire, but in the past 'William' had swallowed a lighted cigar without ill effects and I for my part think that the loss of his old friend was the principal cause.

By nature Millard was of rather a shy and retiring disposition, but all that vanished when he had anything to do on behalf of the Society. He was a keen sportsman and loved a day after quail or snipe in the Thana district. While at home, on leave, he always spent part of August grouse shooting in Perthshire and after he retired he rented a shooting lodge in the Rannoch district for several years. After finally leaving India Millard settled in Tunbridge Wells, within easy reach of London, which enabled him to run up for the day to attend to business or visit the fortnightly shows of the Horticultural Society. Attached to his house was a small garden which he soon filled with interesting plants and shrubs, and it is doubtful if there was ever any garden of the same size with as many rare and interesting plants! It was a veritable *multum in parvo*.

Millard married Sybil daughter of James Mackinlay of Edinburgh, and seldom has there been a happier marriage. Mrs. Millard assisted her husband in many ways and her presence at the meetings of the Society was always welcome, where her charming personality made the shy visitor feel at ease. Later when she became crippled with arthritis no husband could have attended his wife in a more unselfish way.

To Mrs. Millard, and her family Mrs. Kirk Green and Dr. Antony Millard, all members of the Society send their deepest sympathy.

And now before closing this inadequate notice I must add a personal note. It was through Millard that I had the chance of going to Bombay and working for the Society which had great influences on my later career. It is difficult to describe the man himself, but we who worked under him in the old days, whether in the Society or Phipson & Co., Sir Reginald Spence, P. M. D. Sanderson and S. H. Prater all received innumerable kindnesses from him which cannot be told here. We all loved and admired him and now that he is gone we treasure the memory of his friendship.

NORMAN B. KINNEAR

E. H. N. LOWTHER

(*Plate*)

Ernest Herbert Newton Lowther, universally known to his friends and intimates as Bob Lowther, died suddenly on April 28th at his home at Burgess Hill in Sussex. He was born in India, being educated first in Simla and later in England at Bedford and Tonbridge schools. It was at the latter that his great love of nature first became evident and there, too, he was weaned by the great naturalist and photographer, Richard Kearton, from that usual boyhood pastime of egg-collecting to replace in its stead a passion for bird-photography. In 1911, after his return to India, where he followed in his father's footsteps in the service of the East Indian Railway, he took up with enthusiasm the photography of India's birds, an enthusiasm which later became a ruling force in his life, resulting in the fine work which for several years graced the pages of the *Journal* as well as the walls at a number of Exhibitions, and culminated in the publication of 'A Bird Photographer in India' and, in conjunction with the writer of this notice, of 'The Breeding Birds of Kashmir'. On his retirement from the railway in 1945 he had risen to be Divisional Superintendent at Lucknow, but it was while stationed at Allahabad and earlier in the Dhanbad area that he did much of what is probably his best work, making the most of his opportunities to photograph the birds of those districts made famous by Allan Octavian Hume. Bob Lowther had a great capacity for making friends and all who met him at once came under his spell. He was kindness and generosity personified and had a delightful sense of humour which was quite infectious. A story which he used to tell almost against himself was how the chairman at one of his nature lectures in India—who in fact was his chief—humorously introduced him to his audience with the words, 'I believe Mr. Lowther in his spare time is a railwayman'. Although he retired from India with impaired health after 34 years' service, his love for bird-photography did not wane. He at once threw himself into the study and portrayal of British birds in which pursuit he was already making his influence felt. In June 1951 he visited the Isle of Fetlar in the Shetlands where he obtained many outstanding photographs of some of Britain's rarer birds, and up to the very day of his death, although his health was far from good, he was planning a second trip for this year. All who knew and loved him will feel relieved that at the last he was spared lingering pain and that inactivity which would have been so irksome to him. His wife took a great interest in his bird work and accompanied him on many of his trips in Kashmir and elsewhere. It goes without saying that all members would wish to join with me in recording here our deepest sympathy with Mrs. Lowther in her grievous loss.

R.S.P.B.

REVIEWS

1. MY INDIA. By Jim Corbett. Twelve chapters. Pp. 190 (9½″ × 6½″). Sketch map, front and end inside-cover maps. Bombay 1952, (Oxford University Press). Price Rs. 6-12.

The India of this book is that portion of the Lower Himalayas between Hardwar and Nepal made known to readers of the author's two previous publications, 'Man-eaters of Kumaon' and 'The Man-eating Leopard of Rudraprayag' reviewed in this *Journal* [Vol. 45 (1), 1945 and Vol. 47 (4), 1948]. The end-maps also include the country below the foothills exploited for three years by the notorious robber and plunderer of the well-to-do—Sultana, dacoit of the Bhantu criminal tribe (in present political parlance 'Scheduled Tribe') as related in chapter VII.

The Introduction gives a quite admirable description of the Lower Himalayas, and how good it is will be realised by the ordinary reader and even more by those who, like your reviewer, wandered during some years of work and sport among those delectable hills and valleys. The sketch map opposite p. 190 shows where Mokameh Ghat is on the south bank of the mighty Ganges east of Patna in North Bihar and scene of the narrative in chapters VIII to XII.

Those who have read Corbett's two shikar 'thrillers' will remember his gift of writing simple yet dramatic prose which has an air of verisimilitude. That is what you also find in these tales of the hill people. You sense that *this* is what happened, *this* is the scene word-pictured before your eyes. Here, in this small book, you have a true picture of the lives and manner of living of 'The stout-hearted people, who with infinite labour have made these terraced fields, live in a row of stone houses with slate roofs bordering the rough and narrow road that runs from the Bhabar, and the plains beyond, to the Lower Himalayas.'

The killing of helpless women by man-eating tigers is a very sad and gruesome business, and the story around the life of 'The Queen of the Village' grips one's attention in every line. In connexion with this beast Corbett makes the dogmatic remark that 'tigers have no sense of smell'. The habits of the tiger do not require that he should have a keen sense of smell, but there are related instances in the Society's journal, and happenings within the personal experience of the writer, that the tiger can sometimes show he has both a hound nose—though a poor one—and a winding nose too. In his narrative there is demonstrated the great harm an inexperienced sportsman can bring about.

Kunwar Singh (Ch. II) was quite right: those who shoot in jungles should be able to climb trees. In the matter of K.S.'s later days' near-fatal illness there are perhaps none of us who would have ventured to act against religious observances as did Corbett, and by which he saved the life of his friend. That indicates his intimate knowledge of the people and the influence he had through unfailing sympathy and understanding. In the stories around the life of Mothi (Ch. III) is another instance of lamentable action—or want of action—on the part of three tiger-hunting 'sportsmen'. Fortunately, in those days so well known to your reviewer, such occurrences can have been very few. In the narrative woven around the life of Mothi is much of interest. There is, for instance, the very true remark that wounded wild boars have to be treated with very great respect. Again we meet Robin of uncertain lineage but treasured memory who was so 'valiant' yet so brave. Perhaps among his ancestors was the spaniel of Williamson's day who, trained to 'point' marauding forest leopards, was killed at his fiftieth success.

In pre-red-tape days we have a vivid insight into the time when district officers in some parts of this country used effectively to carry out their manifold duties while moving from camp to camp. Among his varied official experiences your reviewer ofttimes settled cases of many kinds while on the march. The people liked such methods, for they were not called away from their homes for days on end, and the open air settlements being seen and heard, not only by the parties themselves but by the villagers also, few dared to speak false witness in such surroundings.

Many are the deeds of unthinking heroism performed by the jungle dwelling peoples of India. A number are personally known to the writer but none to equal the tale of the 'brothers' Narwa and Haria related in Ch. VI and pictured on the cover-wrapping of this book. The story of the two lost children woven into the Law of the Jungle is a poignant tale.

It is the present-day custom in the public press to accord the legendary name of 'Robin Hood' as a kind of honorific title to dacoits and robbers some of whom by no means deserve it. Sultana of Chapter VII was apparently somewhat deserving of the appellation, though his many deeds did eventually earn him the dishonour of a hempen rope. Your reviewer happened to be at Lalkua Junction on the afternoon of 23rd March 1923 on the way to Ramnagar when he met the redoubtable Young of the police all set to lead his special police force on a night march through the forests to surprise the elusive Sultana and his gang. That venture failed owing, we heard later, to the accidental (?) discharge of a rifle. We had not previously met Mr. Young, but being told there was some doubt as to whether the hoped for shikar elephant would be available at Ramnagar he at once offered the loan of his own animal. That it was not found to be necessary did not detract from the prompt kindness of his generous action. The tale of his further doings and his final capture of Sultana is well related by our author. Yes! that very able and physically active police officer did look as if weighed around 280 lbs.

Chapters VIII to XII are concerned with twenty-one years of work at Mokameh Ghat. They were years of hard and anxious toil in a climate very different from the salubrious hills of his home near Naini Tal. These fifty-eight pages give the reader much that is interesting and informative regarding the character of the author and the lives of the people with whom he lived and worked all those years. Those of us who have acquired knowledge of the peoples of India through long residence in this country will know how true is Corbett's narrative of his days and doings at Mokameh Ghat. Some will think he was of a too generous nature.

This book should attain a very wide circulation, and all who have the fortune to read it will look forward to more from the author's pleasingly descriptive pen.

R. W. B

2. THE PHEASANTS OF THE WORLD. By Jean Delacour. Pp. 347 ($11\frac{3}{4}'' \times 8\frac{3}{4}''$). Illustrated with 16 coloured and 16 monochrome plates by J. C. Harrison, 21 maps and diagrams. London (Country Life Ltd.), New York (Charles Scribner's Sons), 1951. Price £7-7*sh.*—$35.00.

Between the years 1918 and 1922 Dr. William Beebe published the four lavishly illustrated but somewhat unwieldy volumes of his monumental 'Monograph of the Pheasants'. Before commencing the task he undertook expeditions to almost every part of the world where pheasants are found in the wild state, including the homes of some of the rarest species, observing and studying their habits and recording meticulous data concerning their habitats and ecology. Small wonder, then, that his book on this fascinating group of game birds should be what it is universally acknowledged—the most complete natural history of the pheasants ever produced.

Beebe's 'Monograph', however, apart from its size and weight which render it somewhat formidable for constant reference, has long been out of print. In the years since its publication, also, a good deal of additional knowledge has accumulated, and several new forms of pheasants have been described. Therefore the need for a new work on this group of birds was evident. Equally evident was the fact that no living ornithologist was better qualified for undertaking the task than Mons. Jean Delacour. His field researches and experience with pheasants in the Indo-Chinese countries and over 40 years of pheasant keeping and breeding in his far-famed aviaries in France (completely destroyed twice in each of the World Wars, but now again in the course of rebuilding), and his eminence as a systematic ornithologist are sufficient guarantee for the quality of this production.

The plan of the book is simple and rational. It opens with a general account of the pheasants as a group. This is followed by a chapter on their acclimatization in the aviaries of the world, and then comes the treatment of each species and sub-species separately headed by a concise description of the bird and its general habits and behaviour, particularly from the aviculturist's angle. Accounts of habits of most species in the wild state are reduced to a minimum since these have been fully treated in Beebe's Monograph and its subsequent one-volume abridgement, 'Pheasants, their Lives and Homes'. Only one new genus and 4 new species have been discovered during the present century including the peacock-like *Afropavo* from the Belgian Congo in Africa, a continent hitherto considered devoid of the true pheasants and as possessing only Guinea Fowls, Francolins and Quails in this family. The real home of the pheasants of course is Asia, particularly south-east Asia.

On a critical evaluation of the various classes of characteristics possessed by the pheasants, Mons. Delacour maintains 16 natural genera in place of the 22 or so hitherto recognized. It is refreshing to find that in keeping with the excellent review of the family Anatidae (Ducks, Geese & Swans) published by him some years ago in conjunction with Dr. Ernst Mayr of the New York Museum, here also the importance of display and behaviour patterns, and bionomics in determining natural relationships and grouping is emphasised as against the purely morphological characters evinced in dead museum material. Thus the lumping of seven genera with laterally compressed roof-shaped tails under the single genus *Lophura* (e.g. Kaleej, Silver Pheasant and Fireback)—termed by the author Gallopheasants—all characterized by a whirring of wings during display, as in *Syrmaticus*, seems a thoroughly rational arrangement with which perhaps few ornithologists with field experience of these birds will be inclined to quarrel.

But what precise value to place on each morphological character still seems largely to be a matter of individual taste and fancy, and it continues to amaze (or amuse !) and mystify what one may call the non-systematist onlooker. For instance, while some systematists lay great store by the number of feathers in the tail, basing even genera on this character, others treat it as of no consequence. Thus the genus *Lophura* as here recognized encompasses birds with 14, 16 and up to 32 tail feathers. Moreover, it contains species that are crested and others without a crest; two species possessing blue face wattles while all the rest have them red; in some species the rectrices are blunt, short and straight, whereas others have them long, pointed and curved.

More mystifying still is the great importance sometimes given by the same ornithologist to such a feature as the bill, its size and shape, in one instance, while its significance is ignored or explained away in another. As a case in point, on p. 25 shape and size of bill is included among the main morphological characters separating the various genera of pheasants; on p. 184 the similarity in bill between *Crossoptilon* (Horned Pheasant) and *Catreus* and *Lophophorus* (the Cheer and Monals) in nonchalantly dismissed with 'But such late acquired functional characteristics are of little meaning as an indication of affinity.' Well may the aforesaid onlooker wonder !

Gaps in existing knowledge are usefully indicated; the precise geographical ranges of many pheasants, and even the provenance of some seen in aviaries, are unknown. A few species are known only from captive specimens and have never been observed in a wild state; 'One incomplete feather is all the information we possess of a certain striking species of Argus'. The eggs and chicks of several species still remain undescribed. Thus the vast amount of work still to be done by field ornithologists is here made manifest.

As a result of mature experience of pheasant keeping and breeding, hints are offered on practical problems such as acclimatization, housing, feeding and rearing of the different species—their procurement, transport, establishment and diseases. The notes on the feeding and care of chicks should be of special value to zoos and pheasant breeders. 'Pheasants which eat grain only soon become too fat and produce infertile eggs. Variety in food and green food are essential. Oystershell and grit should be available at all times.'

In the main section of the book that follows, a good description of each genus and its taxonomic position, general habits and captivity heads the account. Its various species and sub-species are next dealt with individually, male, female, immature and downy chick being described, together with eggs and distribution. Historical accounts of the introduction and acclimatization of the different species in Europe and America add considerably to the interest of the general reader.

It is gratifying to find that—thanks to the whirligig of time—*Ceriornis* has reverted to the more familiar, onomatopoeic *Pucrasia*. The crow of the cock Koklass is given as 'Ah-croaak! croaak-croaak! crok!, the last note very low.' The reviewer feels that the more usual rendering of the call 'Kok-kok-kok—kokras' or 'Pok-pok-pok—pokras' is as good as any. It is responsible for the Hindustani name Koklass as well as for the Latin *Pucrasia*.

Several of the named races of the Koklass pheasant, for example *bethelae* Fleming and *biddulphi* Marshall, would seem to be little more than stages in a continuous cline, therefore without precisely definable boundaries. As such the reviewer is not entirely convinced that any useful purpose is served by naming the populations. One of the conditions that have been authoritatively laid down for the recognizability of a sub-species is that the differences should be sufficiently 'taxonomic' to be recognizable in museum specimens. It may be that this condition is fulfilled to a greater degree in *Pucrasia macrolopha* than in many other species of birds so treated, but the usefulness of nomenclatorial sub-specific recognition in many cases is certainly questionable. Instead of simplifying taxonomy, it does little more than confuse issues and clutter up synonymy, since it is often rejected by the next reviser who covers the same ground.

In the abounding merits of this work there is little that any one can seriously criticize, but attention may be drawn to a few minor slips which might easily have been avoided. To readers familiar with India it will seem that a little more care in the orthography of Indian names would have been of advantage. For instance, on page 113 Jubbulpore is spelt 'Jubhulpore'; on p. 131 Khasia (Hills) appear as 'Kashia', while on p. 204 Gandak (River) is printed as 'Gandal'.

The westernmost distribution of the Satyr Tragopan is given as the Kattar Valley somewhat west of the Alaknanda valley in Kumaon. It is therefore unlikely that there are 'Afghans' among the other hill natives who bring them down to Calcutta every year, as stated. Kumaon is entirely out of the distributional range of the Afghan!

Absence of any indication in the text of where to turn for a particular illustration will cause some inconvenience to users; likewise a cross-reference on a plate to the relative page of the text would have been appreciated. Between pages 235 and 240 the name 'Kozlova' appears variously as 'Kozlowa' as well as 'Koslova'!

It might be mentioned that the correct Hindustani pronunciation for the word here spelt Kalij (p. 120) is 'kaleej'—the 'a' shortened like the 'u' in 'cut'. The plural consistently written here as 'kalijs' is both odd and difficult to pronounce. Perhaps it would have been better to drop the final 's' altogether and use kalij as a collective noun.

The story of the finding of the peacock-like African bird *Afropavo* in the late '30s is surely one of the most romantic epics of ornithological investigation. The initial clue, supplied by a single feather worn in the hat of a native Congoan in 1913, and 2 dilapidated moth-eaten specimens supposed to be the young of the Common Peafowl, in the neglected corridor of a Belgian museum, led to a special expedition to central Congo in search, resulting in the dramatic discovery of the bird.

As regards the general excellence of the book—text as well as plates—there can hardly be two opinions. Ornithologists are fortunate in getting the benefit of Mons. Delacour's unparalleled experience and intimate knowledge of this group of birds. The book will rank as a classic in its own class.

S. A.

3. PHARMACOGNOSY OF AYURVEDIC DRUGS OF TRAVANCORE-COCHIN. Series I. 25 × 19 cms., Pp. vii + 41, tt. I-X; tables nos. I, IV, VII & VIII are in colour, the rest in black and white. (Published by the Central Research Institute, Trivandrum, 1951.)

This is an interesting series that is now being started by the University of Travancore on Ayurvedic Drug plants. To begin with, the number of tables and their presentation make the little volume an attractive one, the plates are very clear, and even those representing the anatomical structure of the plants are very artistically drawn. The booklet deals with but a few plants, and in each case after a short introduction, the following data are given: the local name of the plant, its distribution and habitat, external morphology, officinal part of the plant, histology, distinguishing features of the root, etc. Both the external morphology and the histology are well illustrated in the plates.

On the negative side I have but a few remarks to offer. According to the practice of the latest edition of the International Rules of Botanical Nomenclature, no comma should be used between the name (generic or specific) of a plant and the name of the author who named the plant. Thus in the booklet under review, it should be *Cyclea peltata* Diels, and not *Cyclea peltata,* Diels, etc.

The question of the name of *Cyclea peltata* Diels is a complicated one, and not easy to solve; one thing is clear: the name *Cyclea peltata* Diels is definitely illegitimate, and cannot be used, even though Gamble in his Flora of Madras, and Blatter in this journal (31 : 556, 1926) use the name in the same sense as in the booklet under review. Diels published his *Cyclea peltata* in 1910; prior to this there were two other authors who had used the same name for different plants: Hook f. & Thoms. in Flora Indica 201, 1855 and Miers, in Contrib. Bot. 3: 236, 1874. *Cyclea peltata* Diels is a later homonym in the sense of Art. 61 of the Rules, and must be rejected.

Subsequent numbers in this series will be eagerly awaited both by botanists and by pharmacologists in India and elsewhere.

H. SANTAPAU, S.J.

4. HEAD AND THORAX OF *STENOBRACON DEESAE*. By S. Mashhood Alam. Part I of Skeleto-muscular mechanism. Edited by Prof. M. B. Mirza. Pp. 74, 9 plates. (Aligarh Muslim University Publication, III, 1951.) Price Rs. 5-8.

While the first publication of the series, previously noticed in this journal Vol. 49 (1); 109, represented the average type of work done in an Indian University this one shows a great advance over it. It is better to take a simple problem and make a good job of it, as in the present case, than to attack a difficult one complaining of want of facilities, shortage of apparatus and even of cooperation. The present publication represents such excellent work that we hope Prof. Mirza, as the Director of Research, will try and maintain this standard. Only the bibliographical references seem to be incomplete. Of some 50 references none represents a paper of German origin. This seems strange knowing that Prof. Mirza himself has had a thorough German training. As in the case of the previous publication ordinary pen and ink drawings have been reproduced on excellent art paper. Although we appreciate the taste, choice of a less costly paper would probably have reduced the price which has been fixed at Rs. 5-8. We note with pleasure that the Vice-Chancellor, Dr. Zakir Husain, has generously financed the publication. It is to be hoped that others in a similar position will follow his noble example.

S. MAHDIHASSAN

5. THE BUTTERFLY FAUNA OF CEYLON. By L. G. O. Woodhouse. 2nd (Abridged) Edition. Pp. xvi+133 ($12\frac{1}{4}'' \times 9\frac{3}{4}''$). 37 coloured and 12 uncoloured plates. Colombo (The Ceylon Govt. Press) 1950. Price Rs. 25.

This 2nd (Abridged) Edition is based on a 1st Edition published in 1942 and incorporates details of the then unknown early stages of an additional 41 species of Ceylon butterflies, leaving now only 42 out of 242 known species undescribed in this respect. This edition has a very complete set of coloured plates which permit purely visual identification: written descriptions in the text are therefore practically eliminated, the letterpress being confined almost solely to other information essential to the collector.

Apart from the financial assistance afforded by an enlightened State Government, this wealth of coloured plates was made possible to a great extent by the economy involved in the use of the author's 'Wax-cum-Gum' method of producing accurate wing-pictures; this is done by transfer to paper of the actual scales themselves, and is, in effect, a double-transfer system. The scales are first removed from the wings by pressing them on to waxed paper; the image thus formed, which is of course composed of inverted scales, is then brought into contact under pressure with gummed paper: when dry it is placed in a bath of petrol which dissolves the wax but leaves the dried gum unaffected. This method obviates the lengthy, expensive and often inaccurate work of painting pictures from which to prepare blocks. The plates are produced by the 3-colour process; as the author himself admits, the results are somewhat 'muddy' and fall far short of the live brilliance of the image. They are, however, very adequate for their purpose, namely identification, and he is most fortunate in being able to produce a book so completely illustrated in colour at so low a price. Whilst realising that first things must come first one sighs, as a worker in India, for a State which has the vision and means to support so complete a work of reference; it must be considered invaluable to anyone studying the butterflies of Ceylon and, for that matter, of South India itself.

To criticise, adversely, a number of points which do not however seriously detract from the real value of the book:

The systematic sequence of Families (page 8 *et seq.*) follows the popular, if illogical, arrangement whereby a commencement is made with the most highly specialised types, and a conclusion with the most primitive. In the work under review however, this sequence is broken by placing the Pieridae before the Papilionidae, whereas the reverse is the accepted order. The author does not explain this departure from system.

A Map is indexed to appear after Appendix 2, but is not in fact included in the copy sent for review.

As regards format this is a superficially attractive volume bound in scarlet leather with gilt lettering and is thus of a style, and also of a size, more essentially suited to a place of honour in the parlour than to the collector's den or to his camp in the field.

The print lacks clarity and is very tiring to the eyes. In places the choice of print-types and their arrangement are very poor; the reviewer refers for example to the index at page (ix) which, incidentally, should immediately follow the title page and should not appear in the middle of text to which it is a guide.

The frontispiece is unusually placed, as it faces the wrong way by conventional standards. It would in any case better have faced the description which immediately follows it.

The Reviews with which the volume commences savour rather of advertisement and do not embellish the opening pages. They seem out of place in a scientific work of this nature, but might have been printed with advantage on the dust-cover.

The fact that pages 1 to 96 are printed on paper noticeably inferior to those which precede and follow it, does not make for uniformity of presentation.

Turning to the plates, interleaving with flimsy paper is presumably essential for their protection, although it has not apparently been thought necessary thus to protect the frontispiece. There could otherwise be no possible justification for the use of this infuriating material particularly, as in the Tropics, where one has frequently to work under a fan. Avoidance of damage to the plates was also, presumably, the reason why the plate descriptions are printed on the outside of each flimsy. Had each description faced the plate the reader would have been saved much time and fuss, and would have had two hands free when comparing a specimen with the illustrations. If flimsies are indeed essential, it should surely be possible to print in reverse on the outside of the flimsy so that the descriptions could be read by transparency at one opening? Alternatively to print on the reverse side of the preceding plate, interleaving with blank flimsies for protection?

More careful editing might have eliminated spelling mistakes, e.g. pp. (xiv) and 57: '*epeus*' for '*epius*'; p. 89: '*Euremas*' for '*Eurema*'; pp. (xiii) and 37: '*Orsotriaena*' for '*Orsotrioena*'; p. (xiv): '*Petrela*' for '*Petrelaea*'; pp. (xiv) and 71: '*Catapaecilma*' for '*Catapoecilma*'; pp. (xv) and 82 '*iarbus*' for '*jarbas*' etc. etc. Vide pp. (xiii) and 27/29: '*Danaus*' is more usually spelt '*Danais*'.

The page heading indicators to numbers of paragraphs are, correctly, at the outside top corners of pages 65 to 123. On pages 27 to 64 they appear, however, at the inside top corners and need full opening to be seen.

It should be noted that two additional 2nd Editions are also available with the publishers as follows:—

(i) *The 'Complete' 2nd Edition*: This is as described above but has a more complete letterpress and includes 7 additional plates depicting genitalia.

(ii) The '*Popular*', or '*Atlas*', *2nd Edition*: This is an abridgment of the 'Abridged' 2nd Edition. The letterpress is cut to an absolute minimum and some of the uncoloured plates are excluded.

M. J. HACKNEY

6. THE STORY OF ANIMAL LIFE. By Maurice Burton, D.SC. Vol. I: The Framework of Animal Life; Invertebrates. Pp. xii + 381. Vol. II: Vertebrates. Pp. viii + 423. Illustrated. (London: Elesvier Publishing Co. Ltd., 1949). Price 63*sh*.

Dr. Maurice Burton here tells the uninitiated something about animal behaviour, beginning with elementary animal forms and working up to the more highly evolved. The subject chosen postulates a knowledge of animals in their natural surroundings and the help of naturalists in all parts of the world has been enlisted for the task.

The first question which presents itself to the reader is how life originated. One of Dr. Burton's collaborators makes as illuminating a guess as any I have come across. Following the course of evolution backwards to a time when there was no life, he imagines a background of sea, a heavy atmosphere rich in gases, and a cooling earth. Some catalyst set off 'the primary chemical experiment' and a froth was formed, a tenuous coherent blob permeable by fluid, air and sunshine. This was the first living matter. It grew and from the physics of its shape divided, and continued to divide as it grew. In the course of a thousand million years it developed into the simplest forms of life that we know.

Fabre has familiarised us with wives who eat their husbands. It is refreshing to learn that women do not always get their own way. In a species of marine bristle worm (*Nereis dumerilii*) the male devours the female and then, to make things even, becomes a female and is eaten in his turn. When we read of the ability of certain animals to cast off an organ and regenerate a new one, we may well ask ourselves whether evolution has done as much for us as is claimed for it. What would we not give for the brittle-star's capacity of growing a new stomach in place of a defective one?

A fascinating account of echinoderms gives an insight into the diverse ways in which creatures propagate their kind. Some shed eggs and sperms direct into the water, fertilisation taking place outside the body and the eggs developing into various types of free-swimming larvae. The body of the larva is generally absorbed by the developing echinoderm, but in one species a portion of the larva separates and grows into the adult animal while the remaining portion swims off, lives for some time and perishes. In some forms the eggs are collected round the mouth of the mother, who raises herself on her arms and forms a brood-chamber in which the young develop. During the time, extending for some weeks, the mother takes no food. Other forms are viviparous, the young developing in the *bursae,* which are pouches normally used for respiratory purposes. An amazing case is that of an Antarctic brittle-star in which the eggs hatch in the ovaries, only one egg developing in each ovary and using others as food. Nature does not appear to have been as careful in this instance as in that of the Lace-wing, described in the portion devoted to insects, the eggs of which are placed on long stalks to prevent the larvae which first hatch out from eating their brothers and sisters.

Aphides or plant lice illustrate one of the ways in which Nature maintains a species in spite of the inroads of numerous enemies. In autumn the females lay one egg each and the adults, male and female, die by the following year. In spring the eggs hatch out and only females emerge. During spring and summer these females reproduce without the intervention of a male. The rate of reproduction is phenomenal, a female under the best conditions producing a young one every half hour. The young ones mature within a few hours and proceed to reproduce at the same rate.

The results of man's interference with nature make sad and instructive reading. The Moas of New Zealand are no more and the Dodo of Mauritius is known only because of *Alice in Wonderland.* The *fer-de-lance* introduced to deter slaves from escaping, and the mongoose brought in later to kill the *fer-de-lance* have both become pests of the sugar plantations. Yet this interference provides a striking example, if verified, of the adaptation of an instinctive function to a change in surrounding circumstances. The tooth-billed pigeon of Samoa used to nest on the ground. After the introduction into the island of rats and cats it took to nesting in trees.

I have given only a few samples of the many interesting facts related. The illustrations in the book have been chosen with an eye to their artistic value. Even a tape worm is invested with beauty and the picture of a chicken-embryo is reminiscent of an Italian medallion. The size of the two volumes makes for ease in handling.

In a book so well got up it is so annoying to find misprints and mistakes in spelling, but they are not so many as to interfere with the enjoyment of the text. There is also an occasional mistake in a reference, for instance in the last sentence at page 94 of Volume I. And I would like to see more references in the text to the illustrations. Thus, the reader's enjoyment of the first reference to the beauty of Venus' Flower Basket would be enhanced by a reference to the superb illustration at page 144 of Volume I.

D.E.R.

The following books have been added to the Society's library since January 1952:—

1. THE BIRDS OF THE MALAY PENINSULA, SINGAPORE & PENANG. An account of all the Malayan species with a note of their occurrence in Sumatra, Borneo & Java and a list of the birds of those islands. By A. G. Glenister (Oxford University Press, 1951) (A Review copy).
2. GRÖNLANDS FUGLE—The Birds of Greenland, Parts II and III. By Finn Salomonsen & Gitz Johansen (Ejnar Munks-Gaard Kobenhavn, 1950).
3. INDIAN MOLLUSCS. By James Hornell (Bombay Natural History Society, 1951).
4. BIRDS OF CEYLON. By W. W. A. Phillips (Ceylon Daily News Press, Colombo, 1949) (A Review copy).
5. BIG GAME OF MALAYA: Their types, distribution and habits. By E. C. Foenander (The Batchworth Press, 1952) (A Review copy)
6. ANIMALS STRANGE AND RARE. By Richard Ogle (G. Bell & Sons, 1951) (A Review copy).
7. CATALOGUE OF THE GENUS *FELIS*. By R. I. Pocock [British Museum (Natural History), 1952].
8. NAME THIS INSECT. By Eric Fitch Daglish (J. M. Dent & Sons Ltd., 1952) (A Review copy).
9. A CENTENARY CHRONICLE OF THE OOTACAMUND HUNT, 1845-1945. By J. F. Smail (presented by Lt.-Col. R. W. Burton).
10. ELEMENTS OF PLANT PROTECTION. By Louis L. Pyenson. (Chapman & Hall Ltd., 1951).

The following books were presented by Mr. Humayun Abdulali to the Society's library on 14-3-1952:

1. THE WORLD OF ANIMAL LIFE. By Fred Smith. 1923.
2. SHOOTING WITH RIFLE AND CAMERA: Filming the *FOUR FEATHERS*. A big-game thriller. By A. J. Siggins. 1931.
3. BOMBAY DUCKS—An account of some of the every-day birds and beasts found in a Naturalist's Eldorado. By Douglas Dewar. 1906.
4. BIRDS OF THE PLAINS. By Douglas Dewar. 1909.
5. THE GUN: Afield and Afloat. By Henry Sharp. 1904.
6. THE TIGER HUNTERS. Brig.-Genl. R. G. Burton. 1936.
7. BIG GAME SHOOTING. Vol. I. By Clive Phillips-Wolley. 1894.
8. THE WAYS OF MAN AND BEAST IN INDIA. By D. King Martin. 1935.
9. JUNGLE BY-WAYS IN INDIA. By E. P. Stebbing. 1911.

10. WITH A CAMERA IN TIGER-LAND. By F. W. Champion. 1928.

11. NATURAL HISTORY OF THE MAMMALIA OF BRITISH INDIA AND CEYLON. By Robert A. Sterndale. 1884.

12. INDIAN JUNGLE LORE AND THE RIFLE: Being notes on shikar and wild animal life. By 'Silver Hackle'. 1929.

13. COMMON INDIAN TREES & HOW TO KNOW THEM (Forty trees common in India). By R. N. Parker (Forest Research Institute, Dehra Dun, Government of India Publication, 1933).

14. *THE AUK*—A quarterly journal of ornithology published by the American Ornithologists' Union. Vols. 61-64 and 66, No. 1.

35 maps of districts and forest areas within Indian limits, were presented to the Society by Lt.-Col. R. W. Burton of Bangalore, and 15 back numbers of various periodicals, viz. the *Journal of Mammalogy*, *The Auk*, *Bird-banding* and *Ebba News* by Dr. C. Brooke Worth of Bangalore.

MISCELLANEOUS NOTES

1. SOME TIGER INCIDENTS

Having read with interest the article 'Leopards in daylight' in a recent issue of the *Field* I thought the following incidents concerning a family of tigers on a tea estate in Cachar, Assam, might interest readers.

In April last this family, the parents and two cubs were reported to be appearing in daylight near the factory and coolie lines of the estate next-door to me, and despite the fact that numbers of people would congregate to watch them they seemed quite unperturbed by the crowds, even when efforts were made to move them by shouting, beating of tins, etc.

The family were taking toll of the coolies' cattle (not altogether frowned upon on a tea estate where a manager is usually worried by cattle trespass !) and as I usually received news of their doings too late to enable me to do anything about it I decided finally to go and waylay them in the hope of getting a shot in daylight.

I went out at about 6 p.m. one evening and having been shown where the family were likely to appear for their evening perambulation I sat myself down behind a bush on the side of a low 'teela' (hillock) about 30 yds. from the path which the tigers were supposed to take.

The country hereabouts, apart from the actual tea areas, consists almost entirely of 'teelas', covered by jungle of varying density, with paddy-fields on the level ground between the 'teelas'.

I had not been sitting for more than twenty minutes when someone up the 'teela' behind me gave a low whistle and pointed away to the paddy-field on my right.

The 'teela', at the end of which I was sitting, formed a ridge about 200 yds. long overlooking this field, and by now most of the labour-force had congregated along this ridge.

I realised as soon as I heard the whistle that something was on the move away to the right; so clambering down over a bamboo fence into the field, I ran across it to a deepish nullah about 12 ft. wide which ran down the centre of the field, parallel to the ridge and about 50 yds. from it. Along the edge of the nullah there were odd clumps of cover and having reached these my boy and I spent the next few minutes racing up and down, peering through the gaps, trying to locate a tiger but unable to do so despite the pointings and gesticulations of the people on the ridge whom we could still just see in the rapidly failing light.

There were apparently two tigers walking along the base of the 'teela' on the opposite side of the nullah but just inside the scrub jungle on the edge of it; the crowd on the ridge could see them but we down on the level could not.

On reaching the end of the 'teela' one of the two turned out of the scrub into the field, right into the open, and started to cross it diagonally towards the nullah. It was only then that we saw him, but for a few moments in the bad light I thought it might be a cow homeward-bound a trifle later than its companions. I soon realised that this was no home-coming cow and accordingly 'froze' behind the nearest bush on the edge of the nullah, at the same time bringing my rifle very slowly up to the aim. The tiger proceeded straight towards where I was standing never once giving the crowd on the ridge a glance, although to him they must have been clearly visible. On reaching the edge of the nullah almost opposite me he stopped and looked up, whether at me or the crowd I cannot say, but by then he was looking straight up the muzzle of my rifle from 18 ft. away; I measured the distance afterwards. The outline of his face was just discernible though the light had gone and I could not make out my sights clearly so I let him have it. This proved to be one of the cubs, a male, 8 ft. between pegs and in very fine condition.

The remainder of the family stayed in the vicinity for sometime making a lot of noise both by day and by night, but although I saw them on several occasions in broad daylight I never succeeded in getting a shot at them. I spent four hours one Sunday afternoon playing what amounted almost to hide-and-seek with one of them, but this time the spectators in the distance did upset the beast or I would have bagged him at a range of a few feet quite early in the afternoon. I had dragged his kill, out of the scrub jungle where he had hidden it, into the open, and a few minutes later he came along to recover it. This he tried four times during the afternoon, but went back each time, popping out at a different spot on each occasion whilst I popped behind a different bit of cover. At the fifth attempt he came up from behind me right to the bush behind which I was sitting. I had put my boy on a 'teela' some way away to signal quietly to me if this should happen and it was not till he started dancing like a dervish smacking his behind that I realised the tiger must be very near my posterior. There was actually just the small bush between us. He skulked after this and as it was starting to get dark I called it a day.

Eventually a coolie was killed, the only remains recovered being half an arm, and the following morning at about 11 o'clock I was informed that a bullock had been killed half an hour before. I went and collected my rifle and my lad Ramadhor and went out to the spot but found only a badly mauled calf, still alive, and no definite information regarding the bullock so I decided to look around the place where the cattle had been grazing.

I was taken into a bottle-necked clearing surrounded by 'teelas', and after searching for a short while found a freshly killed bullock. I was examining the poor beast when Ramadhor in a very audible voice said, 'There's a tiger looking at you from the base of the "teela" opposite'.

Four of us had entered the clearing in full view of these beasts (there were two of them) and yet they had taken not the slightest notice of us.

Two members of the party suddenly remembered urgent business elsewhere and removed themselves hastily leaving Ramadhor and myself. Neither of us could make out how exactly the tigers were sitting as they were on a slope and we could only see their bodies through a gap in the foliage, neither of their heads being visible. However, after we had been arguing for a full ten minutes in perfectly normal voices 25 yds. from them, without the tigers resenting our presence at all, one of them yawned. This gave me a line on a nose, the upper half of the face being obscured by two large leaves. As neither beast appeared to have the slightest intention of moving, I made Ramadhor stoop in front of me and resting the rifle across the back of his shoulders fired at the centre of the visible nose. One tiger bounded away through the jungle up the 'teela' but the owner of the nose merely keeled over and after one or two twitches I heard a gasping gurgle and then silence. I fired a second shot into the underside of the chest, which was now visible, to make certain the beast was dead.

It was then exactly 12.20, so that from the time when I had first arrived on the scene and found the mauled calf a mere forty minutes had elapsed.

The bullet I found afterwards had gone in at the centre of the nose, broken the lower jaw, almost torn out the tongue completely and then proceeded through the back of the throat and into the vitals.

I was disappointed to find that this was the other cub, also a male and exactly the same length as the first.

Two evenings later I stalked to within a few yards of one of the parents trying to remove a kill which I had had pegged down; this time however, my presence was resented and after a couple of snarls the beast went off roaring and presumably rather hungry. The same night at 10.30 I went after the two of them, clad in my pyjamas, as one of the estate lorries returning late had passed them sitting just below the road not far from where the pegged-down kill was, but although I saw them both I was unable to have a shot.

I haven't seen anything further of this pair for a while now and I would like to think that a new family is afoot in which case they will pass with my blessing if we meet again.

c/o Grindlay's Bank Ltd.,
54, Parliament Street, H. R. D. ROBEY
London, S.W. 1,
March 17, 1952.

2. POST-SCRIPT ON 'RABIES IN TIGER'

In continuation of the discussion on rabies in the tiger and vulture, the following quotations and comments are proferred.

1. 'The vampire bat is the only known host that can act as a true carrier of rabies over an extended period without exhibiting evident illness. The majority of vampire bats that contract rabies

evidently die of the disease, but some have been shown to be capable of transmitting the disease over a period of five months, without showing symptoms of rabies'. Harald N. Johnson, 1947. Rabies. *Annals of the New York Academy of Sciences,* Vol. XLVIII, Art. 6, p. 373.

2. 'With rare exceptions, intracerebral injection of concentrated virus suspensions is fatal to animals. Young birds are generally susceptible to intracerebral inoculation, while older birds are often refractory.' ibid., p. 366. Comment: The word, 'animals', in the above passage is presumably used in the lay sense to mean 'mammals', as suggested by the immediately following reference to birds. Hence since vultures attending carcases are scarcely fledgelings, it is difficult to imagine that they would even occasionally be carrying rabies virus as true hosts. Furthermore if a carcase were that of a victim of rabies, there is no reason why carrion-eaters at the same feast need to be inoculated by a mechanically contaminated vulture's beak —they could just as easily contaminate the mucous membranes of their own mouths directly from the carcase. However:

3. ' . . . . the virus in the brains of animals dead of rabies is inactivated rapidly in hot weather.' ibid., p. 365. Comment: This would probably apply to virus in other organs also. (Virus has been found in 'lactating breast tissue, stomach mucosa, pancreas, kidney and adrenal tissue,' but not in 'spleen, liver, lymph nodes, bone marrow and sex glands.' ibid., p. 367. Comment: Presumably vultures are not sufficiently expert anatomists to distinguish among these several organs and tissues. General contamination of carrion-eaters may logically be inferred from the foregoing information.

4. In the United States, where rabies is common in many wild mammals, I witnessed the bite of a vulture in the case of a human being. I can think of no reason why American vultures should be less rabid than Indian ones. The bitten man happened to be my uncle who was obligingly restraining a Black Vulture, *Coragyps atratus,* as I prepared to photograph it and its fledgelings. Suddenly the bird reached around and gave one of the knuckles of his middle finger a ragged cut with its foul beak (it had disgorged when I pounced on it a few moments previously, just as it darted from one of the entrances to its nest beneath a pile of boulders). We were far afield and were unable to treat the cut with anything better than a bit of seventy per cent. alcohol that had been taken along for preserving specimens (not uncles). There was no subsequent cauterization or antirabic treatment, for we did not then think of rabies. This was more than twenty years ago, and my uncle is living and well today, still enthusiastic about vultures[1].

Incidentally I have the photographs that I took. In the first picture my uncle is holding the vulture with its wings out-stretched, but in the second—after being bitten—he has a firm grip with his uninjured hand about the bird's neck. The bird was ringed and liberated; its psychological scar may have exceeded the physical one of my uncle's finger, but not that of our individual memories. In any case, we concluded unscientifically that vultures, far from propagating viruses and bacteria in their saliva, gastric juice, or other body fluids, may have virustatic or bacteriostatic substances in these media that are consequences of Natural Selection through aeons of carrion-eating.

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[1] Of course Mr. Daver never suggested that *every* individual vulture carried the rabies virus, so that the case cited is, by itself, no criterion.—EDS.

THE ROCKFELLER FOUNDATION,
BANGALORE, MYSORE, C. BROOKE WORTH
April 10, 1952.

3. A RECORD OF THE CHEETAH (*ACINONYX JUBATUS* ERXLEBEN) IN CHITOOR DISTRICT, MADRAS STATE

During the night of March 28/29, I had occasion to travel between this place and Bangalore, the route I use being via Renigunta, Tirupati, Chandragiri and Chitoor. Whilst passing through the hilly section of country, through which the road winds, between Chandragiri and Puthalkonda, at about 1.30 a.m., the headlights picked out the gleam of eyes and on drawing closer, we saw what we thought was a small leopard, sitting well erect on the left side of the road gazing toward the car. I slowed down immediately and when the car was some fifteen yards from the animal it stood up and walked across the brilliant beam of the headlights and, after standing on the right side of the road for some five to ten seconds looking at the now stationary car, it went down the embankment. Having no torch I could not either follow it or make any further observation; although I did turn the car across the road the light beam did not light up the ground below the embankment.

However, the cheetah gave us ample time to watch it as it liesurely walked across the road and stood on the right-hand side. The slender build, domed head and long limbs together with a very heavily spotted coat were too distinguishable to classify it as anything else, night or no night. The roadside was too loosely dusty to give a clear pug mark, but what pugs there were were smaller than one would expect of a leopard of corresponding size. By rule of thumb, I should judge the animal to have been some 5 feet in length, inclusive of the tail.

The country at the point of observation consists of a semi-cultivated valley, the crops being for the most part sugar-cane and orchards of mango, interspersed with the bush-covered flanks of the hills on either side. These hills are for the most part huge sheets of stone and tumbled masses of boulder and scree, in the fissured gullies of which there is a struggling growth of thorn bush and cactus. I have driven through this stretch at least a dozen times at all hours of the night and day within the past year and although I am told that Nilgai (*Boselaphus tragocamelus*) and 'Wild goats' (Muntjac ?) occur together with wild pig I have not seen any signs of them along the road mentioned, although since I do know that these animals, together with Chital (*Axis axis*) occur along the very narrow belt of secondary jungle at the immediate foot of the most eastern range of the Eastern Ghats and that the animals within the Eastern Ghats in Cuddapah have ample forest within which to move, it is very probable that the species mentioned do occur. However, by far the commonest animal throughout the area is the Blacknaped Hare (*Lepus nigricollis*), which occurs in profusion. I have gone into this at length as I am interested in placing a finger on a reliable source of food supply to attract carnivora, apart from the village herds of goats and cows, upon which they also may possibly prey.

This is the second occasion in my life that I have seen the Cheetah in its wild state, or more closely, the second time in some fifteen years of intelligent observation in the forests of Bihar, Orissa, Central India and Burma for the most part.

Regarding an animal such as this, which is fast becoming extinct in India, one is very reluctant to report the exact localities of occurrence out of fear of those trigger-happy gentlemen who do not understand the fine line between sport and slaughter. However, I think the Chandragiri Cheetah will be safe as the local population is not given so much to shikar.

c/o POSTMASTER,
P.O. GUDUR, NELLORE DIST., K. M. KIRKPATRICK
April 11, 1952.

4. THE 'DIPPING' HABIT OF THE TAPIR (*TAPIRUS INDICUS* CUV.)

Blanford's Fauna (p. 479) states that the tapir is fond of water, and is said to plunge in and walk along the bottom, instead of swimming. There appears to be little further information on record, and it might be interesting to draw attention to a note included in 'The Story of a Tapir' by J. A. Hislop in the *Malayan Nature Journal,* Vol. V, No. 2, June 1950 (pages 92 to 95) in which he relates the experience of a Mr. C. E. Jackson:—

'While discussing the tapir with some Sakai I remarked that I could not understand how this animal managed to survive and flourish . . . . particularly against tigers. The Sakai replied that the senses of sight, hearing and smell were most acutely developed in the tapir, and that it also had the ability to remain under water for fairly long periods. In fact, when harassed by a tiger, tapirs had been known to enter a river and walk downstream on the bed of the river for a considerable distance in order to put the tiger off the scent. I was not aware of the tapir possessing all these powers attributed to it and was very sceptical about its sub-aqueous abilities. It was, however, not very long after this conversation took place that the following incident occurred.'

He then goes on to relate how he received an urgent telephone call from the Assistant Engineer, Waterworks, Kuala Lumpur, informing him that a tiger had attacked a tapir at the Ampang Reservoir and that both animals had fallen into the 'intake well'. Mr. Jackson visited the place with Mr. H. M. Pendlebury of the Museums Department.

The intake well was a concrete structure some twelve feet square and about the same in depth and a fully grown male tapir was standing in the bottom of the well which was dry. There was no sign of the tiger, but there was however evidence to show that it had been in the well and had sprung out and made off into the jungle.

'The problem then was how to get the unfortunate animal out of its predicament. We first of all flooded the well, thinking that the tapir might swim or float to the surface, but when it failed to appear after a few minutes we speedily emptied the well, thinking that it might have drowned. He was there, still in his original position and seemingly quite unperturbed and none the worse for the immersion. We thereupon repeated the performance, leaving the water in for a much longer period, but with exactly the same result.

Other means had to be resorted to, and it was with some misgivings that I allowed myself to be lowered on a rope in order to make a second rope fast round the tapir's middle, and that accomplished I made a rapid exit. With some twenty labourers heaving on the rope and the well again flooded, the tapir was brought to the top and levered out on to dry land.

The proceedings took over two hours and during that time the tapir made no sound nor showed any sign of aggressiveness whatsoever. It was however found to be badly mauled and was destroyed.'

c/o Faiz & Co.,
75, Abdul Rehman Street,
Bombay,
June 16, 1952.

HUMAYUN ABDULALI

5. AN ELEPHANT'S STRIDE

I saw 3 elephants (tuskers) stride, without apparent difficulty, across an elephant trench round a *ragi* field, in the moonlight on the night of the 11th instant. The width of the trench was 5½ feet; the stride measured in each case 8 ft. 2 in. from centre to centre of the footprints. Had I not myself seen this occur I would have considered the feat incredible.

Honnametti Estate,
Attikan P.O.,
via Mysore (S. India),
December 15, 1951.

RANDOLPH C. MORRIS

6. MEASUREMENTS OF AN INDIAN BISON HEAD (*BIBOS GAURUS*)

With reference to Miscellaneous Note No. 5 in your journal of April 1942, Vol. XLIII, No. 1, I give below measurements of the first ten heads of bison shot in Burma and recorded in Appendix I of the

Burma Game Manual 1929, which do not appear to have been considered for the world's record claimed by Mr. S. C. H. Robinson.

No. (1)	Horn measurements (2)	Length (3)	Girth (4)	Tip to tip (5)	Widest outside (6)	Remarks (7)
		Inches	Inches	Inches	Inches	
1.	Right Left	$36\frac{7}{8}$ $33\frac{7}{8}$	$22\frac{1}{2}$ $22\frac{1}{4}$	$31\frac{1}{2}$	46	(I.F.S.B.) Owner :—D. H. Allan. Shot in Upper Chindwin.
2.	...	38	19	16	40	(I.F.S.B.) Shot by W. S. Thom, Myitkyina.
3.	Right Left	$34\frac{1}{2}$ 34	$19\frac{1}{2}$ $19\frac{3}{4}$	39	$46\frac{3}{4}$	A. Hazlewood, Bassein Forest Division.
4.	...	$33\frac{1}{2}$	21	$29\frac{1}{2}$	$44\frac{1}{4}$	(R. W.) Owner :—J. McF. Petters.
5.	Right Left	$34\frac{1}{2}$ 33	$20\frac{1}{2}$ $21\frac{1}{2}$	$18\frac{3}{4}$	$39\frac{1}{2}$	Shot by L. D. Edmondston, Upper Chindwin, 1926.
6.	Right Left	33 32	$20\frac{5}{8}$ $20\frac{1}{4}$	25	...	Shot by E. F. Batten, Bombay-Burma Trading Corporation, Limited, Matu Reserve, Upper Chindwin, 1911.
7.	...	$32\frac{1}{2}$	20	26	$40\frac{1}{2}$	Shot by A. L. Bacon, Mogok.
8.	Right Left	$32\frac{1}{2}$ $32\frac{1}{2}$	19 20	24	39	Shot by F. R. Dickins, Magwe Forest Division on 22nd June 1928.
9.	...	32	$19\frac{1}{4}$	26	40	(R. W.) Owner:—A. E. English.
10.	Right Left	$34\frac{5}{8}$ $34\frac{1}{4}$	$17\frac{3}{8}$ $17\frac{3}{8}$	$14\frac{7}{3}$	36	Found in the house of *Myothugyi* at Yinmabin, Lower, Chindwin District.

MAWLAIK,
UPPER CHINDWIN/MYITTHA DIVISION,
February 26, 1952.

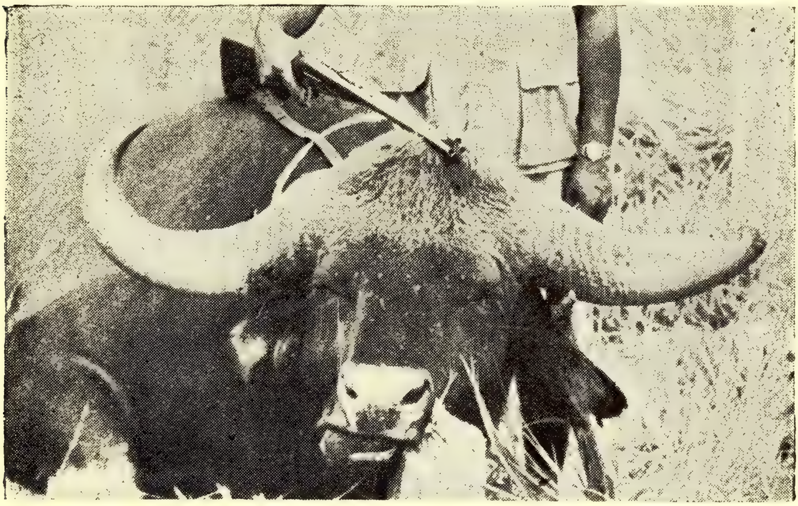
H. G. HUNDLEY
Divisional Forest Officer

[In Rowland Ward's 'Records of Big Game' (1928) the largest head of the Malayan Bison is widest outside 38″ and circumference at base 16½″. Foenander in his recent book 'Big Game of Malaya' p. 61 records one shot by Da Prah at Kuala Jelai in Negri Sembilan as 46″ outside width and circumference at base 20½″. Length from tip to tip across the forehead (sweep) 78½″.—EDS.]

7. THE RECORD SPREAD OF GAUR HORNS (*BIBOS GAURUS*)

(*With a photo*)

On 27th November, 1951, my friend, Mr. Maruthasala Gownder Landlord, Saravanapatti Village, Coimbatore District, shot a huge solitary bull bison in the Talamalai Range of North Coimbatore Division.



The left horn is blunt and worn out to nearly one-third of its length (photo). Had it been full, the spread would have measured another three or four inches. As it is, it measures 48 inches. I was on the spot and took down the measurements carefully. They are as follows :

1. Length of right horn	... 30½″
2. Length of left horn	... 19″
3. Girth of right horn	... 20½″
4. Girth of left horn	... 19½″
5. Spread. Widest outside	... 48″
6. Span. Tip to tip in straight line	... 44″
7. Sweep across forehead	... 73″
8. Girth round body (behind shoulder)	... 10 ft.

9. Height at shoulder ...	6 ft. 5½″
10. Total length over curves from nose tip to end of tail ...	13 ft. 10½″

15/15, Perumal Koil Street,
Fort, Coimbatore,
January 4, 1952.

B. SUBBIAH PILLAY

[Messrs. Van Ingen & Van Ingen, taxidermists of Mysore, to whom the head was sent for mounting, wrote to us: 'The bison head received from Mr. Maruthasala Gownder cannot be measured in its present condition as the horns are severed at the base and for some reason a greater part of the core remains firmly inside of the horn. Whether the boiling has caused this or disease we cannot say. Bison heads with horns should never be boiled.'

In a subsequent letter they indicate the following measurements:—

Widest outside ...	47″
Girth ...	19½″

The letter adds 'it is unfortunate that one horn is broken off at the end and 10″ missing, spoiling its symmetry and a beautiful trophy.

'These measurements are likely to have differed from the original taken when the bison was shot in view of the fact that the skull of this bison appeared to be very porous and the bone was soft and light. The cores of the horns were each four inches in length and hollow, whereas the horns themselves were solid nearly as far as the cavity allowed for the core.'

This certainly appears to be the Gaur head with the largest spread so far recorded. Rowland Ward's 'Records of Big Game' (1928) gives the widest outside as 44¾″ and circumference at the base 20″ (Lt.-Col. C. H. Stockley, Siam).

The largest head from South India is: widest outside 43⅜″; circumference at base 17½″. It was shot at Parambikolam (Cochin State) by G. Elliot Browning—Eds.]

8. CATTLE DISEASES AND WILD LIFE

Between 15 and 20 bison have died recently from foot and mouth disease, and several more are affected, in the Kollegal Division of the Coimbatore District, having caught that disease from the village cattle penned in the hill forests owing to the lack of grazing down below.

Had these cattle introduced rinderpest as well, a tragedy similar to that of 1929 would have overwhelmed the large number of bison here.

Honnametti Estate,
Attikan P.O.,
via Mysore (S. India),
June 7, 1952.

RANDOLPH C. MORRIS

9. A 'RED' PORCUPINE

About six years ago I was staying on the Bababudan Hills in Mysore. I was sitting on the hill-side one afternoon watching for animals. A small red animal came up the ridge towards me, in and out of the rocks, much of the colour of a British fox. Eventually it saw me when about 20 yards off and dived into the rocks, by which time I had made certain it was a porcupine.

This in itself would not be conclusive, but later, in another place I found some porcupine quills on which a bright rusty red replaced the white bars, partially or entirely. This was proof positive.

Col. Phythian-Adams, with his extensive experience, tells me he has never heard of a red porcupine, so it might be worth looking for a specimen.

'STOCKBRIDGE', HAROLD COLAM
OOTACAMUND,
August 1, 1951.

[In 1863 Francis Day, a Fellow of the Zoological Society of London and of H. M. Madras Medical Service, in his work on Cochin entitled 'The Land of the Perumals' pp. 446-447, refers to the Orange Porcupine (*Hystrix malabaricus*). He states that during his residence in Cochin he was informed by the natives that 'a species or orange-coloured Porcupine was found in the neighbouring hills and its flesh was more highly esteemed for food than that of the common variety. It was said to be a smaller species, and that the two never lived in the same locality. They were also found at various places along the Ghats of Cochin and Travancore. At Trichooe (Trichur ?) about 40 miles north-east of Cochin there was a colony of these animals. They had formed their burrows in the laterite rock. . . . The native sportsmen declare that aroma from these burrows is quite sufficient to distinguish this species. . . . In captivity they lose much of their orange colour; and their vividness greatly decreases when they are ill.'

Sclater in the *P.Z.S.* 1865, pp. 352-356, described this as a new species under the name of *Hystrix malabarica*. Later in the *P.Z.S.* 1871, pp. 233-234, he refers to a specimen in the Zoological Gardens in London which 'after sometime gradually lost the splendid orange colour in the quills and became undistinguishable in external appearance from other Indian specimens. Under these circumstances, I cannot doubt that the colour of the quills is merely due to some local variation, probably to some particular food which they consume; and I have therefore reduced *Hystrix malabarica* to a synonym with *H. leucura*.'

Further information concerning this colour phase in the Porcupine would be interesting.—EDS.]

10. THE DIARY AND SPORTING JOURNAL OF W. P. OKEDEN, 1821-1841

There are some entries which attract attention in this somewhat bare recital of the shooting of elephants, of about 285 tigers, 19 bears, 13 buffaloes, and many deer during nineteen years shoots in the jungles of the Himalayan *terai* from Moradabad to Kheri-Lakhimpur in the present Uttar Pradesh.

All through the Diary it is evident—and also stated—that the main object was not to kill the tigers too soon but bring them to the charge. An aid to this was the rather inefficient muzzle-loading rifle of those days, with its small charge of 1¼ drs. of powder to propel the 18 bore spherical bullet of hardened lead. Okeden gives no details of the rifles used; but we know from General William Rice that this was the weapon in use at that time. Some of the tigers, says the Diary, endured a number of bullets—16, 15, 13 are mentioned—before they succumbed.

Fighting Tigers

There were many gallant tigers:

p. 102. '. . . on coming up the tiger showed good fight, and took a number of shots ere he yielded. 1 hind leg broke, 1 fore ditto, a shot through the back which had gone through and let his guts out, one eye knocked out, and yet he sat on his rump and roared at us, his sound eye sparkling like a fire-ball, and the very picture of savage fury.'

One of the latest entries:

12th April 1841. '. . . He was a large, powerful male and proved himself worthy of his notoriety. (He had lately fought and killed another tiger, and killed on an average two bullocks a day.) His ferocity, with his eye out, his mouth filled with blood, and still coming on roaring up to the mukna, was magnificent. Alas, I fear I have not many such a sight to see again, for a Dorsetshire coppice holds nothing but a hare.'

Staunch Howdah Elephants

His mukna was staunch, and his other howdah elephant exceedingly brave for she faced many fiercely attacking tigers, though a number of times clawed or bitten.

The Emperor Shah Jehan gave orders for the head and trunk of elephants used or tiger-shooting to be protected down to the end of the trunk with a covering of thick leather studded with sharp nails. Sir Samuel Baker, in his book 'Wild Beasts and their Ways' pp. 35-36, says that elephants used against tigers should have protection of the face and trunk provided in the way designed and described by him. (No mention of sharp nails, and he had probably not read of Shah Jehan's order!).

This sensible idea does not seem to have caught on, for there is no mention of it in subsequent shikar books.

SOME TERMS AND EXPRESSIONS

p. 41. (and elsewhere). '. . . at last she (tigress) stopped in a large tope of *semallow* bushes.'

Perhaps a Forest Officer of the area will be able to give scientific name of this plant? It is not in Gamble's Indian Timbers.

p. 49. '. . . we then fired a ball or two, skimming the *petellahs*.'

They were shooting near a swamp. What is *petellahs*? May be petals of the lotus flowers?

p. 56. 'The elephant went down in what I know not, but I suspect an old *obhee*.' Perhaps a disused well?

p. 63. 'Beat the jheel full of *tantagrass*.'

What is this grass?

p. 74. Okeden shot 'I *stinker*'. From the context, perhaps a deer, but what deer? A stag of swamp deer with immature horn? On several occasions he shot a *stinker*.

p. 108. 16th February 1835. 'Shot a *choukur*, or *dindseoo*, the only one I ever killed. Rode to Moradabad the next morn.'

What creature may this have been? Bird or animal? There is no mention of it in 'Hobson Jobson', and it woud seem that Yule and Burnell had not seen this Diary which was not published but privately printed, where is not apparent in the copy in the Society's Library.

BANGALORE, R. W. BURTON
January 1, 1952. *Lt.-Col.*, I.A. (Retd.).

11. STRANGE BEHAVIOUR OF A HOUSE-CROW (*CORVUS SPLENDENS*)

Recently during the last week of May a curious behaviour of a crow attracted my attention.

Just outside the window from which I was watching him (or her) there is a row of rough flat stones, each stone about eight inches high, meant to hold up earth for a flower bed.

When I first noticed the crow he was trying to pull out a pebble wedged in the vertical interstice between two of the stones. The interstice had a very irregular width ranging from an inch to a quarter of an inch.

The bird succeeded in pulling out the pebble and placed it on the ground at his feet. He next picked up another pebble and inserted it in place of the one he had just removed.

The bird now took a piece of broken Mangalore tile (about the correct size for the purpose) and tried to lodge it a little above his first effort, where the fissure widened to about an inch. The tile, however, dropped off. He made another effort, trying to push it in with small jerky, rather insistent movements of his head and neck; changing position slightly with occasional short hops.

The behaviour of the bird gave the impression that he was trying to accomplish some urgent and necessary task. He was aware that I was watching him and obviously uncomfortable; but still he carried on, keeping one wary eye on me.

He made about three or four unsuccessful efforts trying every time to wedge in the same piece of tile and which would not stay put, but kept slipping off. He might have succeeded if he had chanced to get the tile into place longitudinally.

A quarter of a minute after I first noticed the bird, the disappointment of repeated failure, and discomfort at my proximity probably got the better of his perseverance and he quit.

Has similar behaviour been commonly noted and is there any explanation for it?

Aden Hall,
Nepean Sea Road, DINSHA J. PANDAY
Bombay,
June 15, 1952.

12. THE MATING HABITS OF THE HOUSE-CROW (*CORVUS SPLENDENS*) AND PIED MYNA (*STURNUS CONTRA*)

These notes relate to random and fortuitous observations on the sexual behaviour of birds, and are merely objective records.

(1) At the back of the Forest Rest House at Ranchi on the afternoon of 28th May, 1951, I observed a House Crow on the ground under a Bougainvillea bush standing with its wings crossed over its back fanning and elevating its tail slightly. The head was bent down, and a soft white feather was held crosswise in its beak. Keeping fixed at one spot, it began going round and round 'shimmying' its body continuously. This 'invitation' display continued for very nearly 3 minutes. Another crow (later proved to be a male) who had been watching this intently from one of the tamarind trees closeby, flew down to the first bird (subsequently proved female) calling loudly, and settled a few steps behind her with wings half drooped, but his body also shimmying like hers. He was calling with a loud harsh, throaty caw-caw. He then advanced slowly towards her keeping up his body movements and call. When close to her, he pecked at her rump with his bill, and then mated after getting on her back. As soon as the male got on her back she dropped the white feather. The act of mating lasted hardly a few seconds, after which the birds separated and flew away. Although the male kept cawing all through the act the female was comparatively quiet, and only called out occasionally after dropping the white feather in a low voice very similar to a young crow's while being fed.

(2) The behaviour of a pair in another instance was very different. On 28th March, 1951, at about 8 a.m., I suddenly heard House Crows making a loud commotion on a tree in a corner of the Rest House compound. This tree carried many nests of both the Pied and Common Mynas as well as two of the House Crow, all incomplete and in various stages of construction. Investigation revealed that two House Crows were apparently fighting tooth and nail on a branch of the same tree, close to one of the nests. While locked in combat they lost their perch, but continued grappling with each other in the air till they reached the ground. On the ground one threw the other on

its back, and sitting almost on its chest pecked furiously at the breast feathers of its 'adversary'. This went on for a few minutes, the prostrate one struggling hard to free itself. The crow on top then forced the other to its feet, mounted its back and mated with it. This clarified the sexes of the two. The fight was innocuous and appeared to be some sort of sex play, for no feathers flew while it lasted and none were found littering the spot later.

(3) At about 6.30 a.m., on 9th April, 1951, two Pied Mynas were seen feeding on the ground in the compound of the Forest Office separated from each other by a distance of some 2 yards and calling occasionally. Suddenly one of the birds crouched down low spreading its right wing fully, the head held at an angle, and the wing tip almost touching the ground; the feathers of the crown were slightly raised, and the tail fanned out a bit. It then called out twice in a low voice, probably to attract the attention of the male which was still busy feeding, unaware of this invitation display. He looked at once in the direction of the call, came running, and treaded her, the operation lasting only a few seconds. The male was calling during the actual mating, but the female was silent. Feeding was resumed by both immediately they separated from each other.

FOREST REST HOUSE,
P.O. HINOO, (MRS.) JAMAL ARA
RANCHI,
February 26, 1952.

13. POSSIBLE ASSOCIATION BETWEEN THE LARGE YELLOWNAPED WOODPECKER (*PICUS FLAVINUCHA*) AND THE LARGE RACKET-TAILED DRONGO (*DISSEMURUS PARADISEUS*)

Mr. Biswamoy Biswas's interesting study of the species *Picus flavinucha* in the current *Ibis* recalls a small problem which exercised my mind towards the end of the war when I had occasion to 'Jeep' between Chittagong and Rangamati at the foot of the Lushai Hills.

I found this fine woodpecker to be far from uncommon from the moment one got into the better wooded areas. During a halt on my first journey I was watching one of these birds in some open forest about fifty yards from the road when I caught sight of a Racket-tailed Drongo mounting from branch to branch, first of an adjacent tree and then in the same one, keeping pace with the ascent of the woodpecker. When the latter flew off through the trees the drongo immediately followed it. A couple of miles further on I had an almost identical experience.

About a month later, shortly after Christmas, I spent a night in a forest-hut about halfway to Rangamati. Nearby were two rather isolated clumps of tall trees bordering a strip of cultivation beyond which the heavy forest recommenced. I soon noticed a Yellownaped Woodpecker in the farther clump. Remembering the previous occasions, I found myself quite disappointed that no drongo appeared to be in attendance. However, after watching the woodpecker for some minutes, it flew off across the fields to the forest beyond. It was immediately followed by a drongo, till then hidden in the nearer clump, which reached the shelter of the forest close behind the woodpecker.

Is there by any chance some association between these species, or were these three consecutive episodes pure coincidence?

'SPRINGS'
BARLAVINGTON,
SUSSEX,
April 6, 1952.

R. S. P. BATES
Lieut.-Colonel, I.A.

[Mr. Sálim Ali has noted a somewhat parallel instance in the Surat Dangs in March, 1948, but with tree pies replacing the woodpecker. A pair of Racket-tailed Drongos were observed 'shadowing' a pair of tree pies (*Dendrocitta vagabunda*), following them about closely from tree to tree and up and down among the branches mimicking their various calls immediately they were uttered—in echo as it were—as if deliberately to mock the birds. This went on for quite a number of minutes and appeared to be some sort of game. After a while one of the Racket-tails, seeming to have had his fill of the fun, flew off. It was now the tree pies' turn; one of the pair promptly gave chase and closely followed the drongo into another tree some distance away where the game was resumed in the form of 'singles'.

It is difficult to explain these proceedings as other than sheer playfulness. There was no malice or ulterior motive noticeable on either side.—EDS.]

14. A CANARY'S CURIOUS REACTION TO YELLOW

Mr. E. D. Avari from Darjeeling sent us the following report of the curious reaction of a German Warbler Canary (mottled yellowish) which was bred in captivity and which has been associated with other canaries pure yellow in colour.

'(*a*) A yellow jersey was held up close to the cage and as soon as the canary saw it he became very agitated and flew quickly around the cage, obviously frightened and would not approach in the direction of the yellow jersey. He then perched, and his breathing was abnormally fast. As soon as the jersey was removed he behaved normally once more.

(*b*) A mirror was put in the cage close to the plate containing bird seed. After a while, the canary flew down from his perch and caught sight of his reflection in the mirror. He appeared very interested, but not frightened and kept looking at his reflection and then away again, stretching his neck and looking around the cage. He then flew off for a while and returned to his plate, proceeding to eat quite unconcernedly in front of the mirror, occasionally looking at his reflection.

(*c*) The yellow jersey was paced in the cage and as soon as he saw it he commenced to flutter around the cage. When he perched his respiration was again noticed to be very rapid. Whilst on his perch he avoided looking towards the jersey, still breathing very rapidly. The jersey was left in the cage for about a minute.

This canary is an offspring of "German Warblers", imported from Germany. His age is 13 years, and he is mule colour. For the last three years, he has lived entirely on his own. For your information the length, breadth and height of his cage are as follows:—8' × 3½' × 3'.'

Subsequent to this Mr. Avari inserted a small ball of yellow wool into the cage assuming that it was perhaps the *size* of the yellow jersey responsible for the perturbation, but the canary's behaviour again changed immediately from normal to marked agitation. Though the quickening of the respiration was not so pronounced as in the case of the jersey there was nevertheless a certain amount of fright and nervousness clearly perceptible. A little later a bowl of seed was introduced by Mr. Avari which was also a comparative stranger to the canary, but the bird promptly hopped down to it.

Dr. N. Tinbergen, the expert on bird behaviour at the Edward Grey Institute of Ornithology, Oxford, at our request gave the following comment:

'The observations seem to suggest that it was yellow colour which frightened the bird. To make sure, it would be necessary to present similar objects of a different colour. If the response were really confined to yellow objects it could be either an inborn response to the male plumage of the species (in which case the abnormal size of the objects could perhaps explain why the bird fled instead of attacked), or a result of conditioning, which would not be impossible if the bird during its association with purely yellow canaries had been seriously hen-pecked by them.'

Dr. David Lack, F.R.S., Director of the above institute, considers the canary's reaction comparable to the Robins attacking red objects (colour of male Robin's breast) as described in his book—'The Life of the Robin'. London, 1943.]

BOMBAY NATURAL HISTORY SOCIETY,
114, APOLLO STREET, EDITORS
BOMBAY,
December 20, 1951.

15. KOELS (*EUDYNAMIS SCOLOPACEUS*) EATING THE POISONOUS FRUIT OF THE YELLOW OLEANDER

The Exile or Yellow Oleander, *Thevetia neriifolia,* cultivated in gardens for its abundant golden flowers and decorative foliage, is highly poisonous. The poison, found in the milky juice that exudes from every part of the little tree, is the glucoside *Thevetin*, similar in action to digitalin but having a convulsant effect as well. The fruit of this tree, in particular, is used as a cattle poison, and has had lethal effects on human beings. There are several of these trees in and around my garden, and the place (Mylapore, Madras) is singularly rich in Koels.

In 1940 I first recorded the partiality of Koels to this bushy tree, and their habit of pecking at its squat, green drupes. However, I did not actually observe them eating the fruit then, and I left Madras soon afterwards. In December 1951 I observed Koels actually eating the pulp (mesocarp) of the drupes. Subsequently I have observed this many times, from nearer than two yards.

The bird sidles up to a fruit and stabs it with its bill, excavating and removing a piece of the mesocarp that it swallows with an upward toss of the head. After two or three pieces have been gouged out and eaten in this manner, the fruit gets detached from its stalk by dint of the repeated pecks, and falls to the ground. There is a definite preference for the riper (bigger) fruits. The Koel then proceeds to another fruit, taking no notice of the one it has sent earthwards, and after eating from 3 or 4 fruits (every one of which falls down after a few pieces have been pecked out) it flies away. A furtive, impetuous haste characterises its fruit eating, and tender green branches are frequently broken in its avid hurry to get at the fruit, (I have noticed the same, literal 'tearing hurry' in Koels consuming the crimson fruit of *Cephalandra indica*). At each visit to the tree, an undisturbed Koel eats about threequarters of the mesocarp of a *Thevetia* drupe (from all its drupes).

This poison-eating by Koels seems most common from late winter to early summer (November to March or April). From April onwards, when Koels here get vocal, their visits to the *Thevetia* trees seem infrequent, but this is a point that requires further observation and verification.

It is to be noted that the pulp of the fruits, consumed by Koels, is known to be definitely poisonous to mammals. The fruits they eat are not so ripe that they are turning dry and brown—they are green and latex can be seen oozing out of the deep, beak-gouged holes that go right down to the stone, in freshly fallen fruits.

Koels are the only birds, above a certain size, that seem partial to the Yellow Oleander. Other birds I have seen on these trees are common mynahs, crows and whiteheaded babblers, all in obvious casual passage and a pair of tailor birds that visit the trees in the evenings. None of these birds, nor the squirrels that pass that way, have the slightest interest in the drupes, nor have I seen any other animal eating the fallen fruit on the ground below. I may add that the bird population of my garden, though varied, is notable for some absentees, the common sparrow in particular.

No certain explanation of the addiction of Koels to this poisonous fruit occurs to me, but it seems possible that the habit conditions them in some way for the breeding season. It is obvious that they are immune to the poison in doses that would, taken in the same proportion to body weight, undoubtedly kill a man or a cow.

PERUNKULAM HOUSE,
EDWARD ELLIOT ROAD,
MYLAPORE, MADRAS,
June 8, 1952.

M. KRISHNAN

[In 'The Birds of Bombay and Salsette' [*J.B.N.H.S* xxxix, (1); 94] Sálim Ali and Humayun Abdulali record a Tree Pie feeding on the ripe fruit of 'Kaundal' (*Trichosanthes palmata*). According to Roxburgh, quoted by Kirtikar and Basu ('Indian Medicinal Plants', I, 580) the fruit is poisonous, and mixed with rice is employed for destroying crows. It seems curious that it should be eaten by such a close relation of the crow and apparently with no untoward effects.—Eds.]

16. DOES THE ADULT CUCKOO EVER ASSIST IN FEEDING ITS OFFSPRING?

On 7th July, at an altitude of about 13,500 ft., an adult cuckoo settled in a juniper tree within five yards of me carrying in its beak a larger caterpillar. I stopped to watch and to make sure that it was not carrying an egg or eggshell, but there is no doubt that what it carried *was* a caterpillar. Before it finally moved off it was joined by a second adult bird. I cannot say for certain whether the bird with the caterpillar was a cock or a hen but believe that it was a hen. Some short while previously I had heard a cuckoo calling—*Cuculus canorus*.

Some two hours later, Major J. O. M. Roberts, who is in charge of our bird collecting activities, passed the same way and in approximately the same spot close to the path, saw a young fully fledged cuckoo being fed by a redstart—probably *Phoenicurus ochrurus*—which he watched for some time. He did not, however, see an adult cuckoo in the vicinity.

There seems to be at least some reason to assume that the adult bird that I saw was in fact engaged in feeding the young one in the absence of its foster-parent.

MANANGBHAT, D. G. LOWNDES
NEPAL-TIBET FRONTIER, *Colonel*
July 14, 1950.

[It is not easy to tell the sex of a cuckoo in the field except by its call notes; there would seem insufficient grounds for Col. Lowndes's conjecture that the one he saw with a caterpillar might be a hen.

The feeding of a fledgling cuckoo by its real parents is, as far as we are aware, unknown as indeed is their showing any interest in their offspring in any other way. What is more likely in the present case is that the caterpillar was being carried for courtship feeding by one bird (o ?) to another (o ?) as has been observed recently in the case of the plaintive cuckoo. More evidence on this is, however, desirable.—Eds.]

17. OCCURRENCE OF THE CINEREOUS VULTURE (*AEGYPIUS MONACHUS* LINNAEUS) IN KAIRA DISTRICT, GUJARAT

On 26th December 1951 and 1st January 1952, in the same area near the village of Mitli, formerly in Cambay State, but now a part of Kaira District, we saw a single cinereous vulture, possibly the same bird in both instances. The first time that it was seen, it was the first to arrive at the remains of a recently shot blue bull. It kept all other vultures at a distance until it had eaten its fill, after which it flew off and the other vultures moved in for their share. Five days later at about the same spot, it was seen in the company of two king vultures, drinking from a puddle of water near a shallow well. Both times the bird was seen from a distance of about 50 yards and examined carefully with the aid of a powerful binocular. Its large size, very dark colour, peculiar feathering of the head, and the mauve coloured *cere* were clearly identified.

Hari Narayan G. Acharya, under a note dated April 16, 1950, in Vol. 49, No. 2 of the *Journal,* writes concerning the finding of a dead specimen of this vulture near Ahmedabad on December 25, 1949. Previous to this, according to this note of Acharya's, the cinereous vulture had been reported only once before in Gujarat in the winter of 1870 by Capt. A. E. Butler. Mitli, where we identified this vulture on the two occasions, is about 40 miles due south of Ahmedabad.

NADIAD,
KAIRA DISTRICT,
February 18, 1952.

HERSCHEL C. ALDRICH, M.D.

18. REAPPEARANCE OF THE LITTLE INDIAN RED TURTLE-DOVE (*STREPTOPELIA TRANQUEBARICA TRANQUEBARICA* HERMANN) IN CEYLON

Hitherto there has been but one record of the occurrence in Ceylon of the pretty little Indian Red Turtle-Dove. Almost exactly a hundred years ago, Edgar Layard, of the Ceylon Civil Service, discovered a small colony nesting, during the hot weather, in palmyra palms in the arid country between Point Pedro and Jaffna in the Jaffna Peninsula, Northern Province. Layard tells us that he collected six specimens and could have killed as many more. His graphic description of his discovery is recorded on page 709 of Legge's 'Birds of Ceylon' (1880).

Since then, this dove does not appear to have been identified in Ceylon. However, on 24th November last year (1951), while I was motoring to the south of the Naval Area, between Pottuvil and Panama on the south-east coast of the Eastern Province, I observed one of these doves feeding on the ground beside the road in an open grassy glade in low jungle country. It was quite solitary and easily approached; it proved to be a ♂ *S. tranquebarica tranquebarica*, in full and perfect adult plumage with the gonads undeveloped.

As a 'red' dove, answering more or less to the description of this species, was seen near Panama in June, 1948 by Mr. and Mrs. D. Boyd-Moss, it is possible that a small colony exists in this neighbourhood, although it is more likely that the bird procured was merely a casual vagrant from the Indian mainland.

TONACOMBE,
NAMUNUKULA,
CEYLON,
April 11, 1952.

W. W. A. PHILLIPS

19. OCCURRENCE OF THE AVOCET (*RECURVIROSTRA AVOSETTA* LINN.) IN ASSAM

On March 11, my husband went duck shooting across the Brahmaputra near Charkhalia Island and shot an Avocet. With its upturned bill there is no mistaking this bird, yet four of the various books on birds that we consulted, stated that this bird is not to be found in Assam.

c/o James Warren & Co. Ltd.,
Dibrugarh,
Upper Assam,
March 15, 1952.

(MRS.) D. SENDALL

[Except for a specimen recorded from Goalpara by Primrose (*J.B.N.H.S.*, xviii, 683) there appears to be no previous record of this species from Assam. Smythies in 'The Birds of Burma' states that it is a vagrant to Burma, the only records being from the Irrawaddy and Chindwin rivers.—Eds.]

20. THE WHITETAILED LAPWING (*CHETTUSIA LEUCURA*) NEAR BOMBAY

Br. Navarro of St. Xavier's High School brought in the skin of a Whitetailed Lapwing (*Chettusia leucura*) shot on 3rd February, 1952 at a tank a few miles from Kalyan near Bombay. The bird was alone.

Stuart Baker (Fauna vi; 184 and *J.B.N.H.S.*, 35, 12) gives its range as extending to Mysore, but I have been unable to trace any Indian record from south of Bombay.

Whitehead recorded the species as common from 7th October to 20th March, at Sehore, Bhopal, Central India, (*J.B.N.H.S.*, xxi, 157). Sálim Ali records it as uncommon in Kutch (first seen 5th August, 1943) while Barnes in 'The Birds of the Bombay Presidency', p. 332, mentions it is an uncommon winter visitor throughout the region, i.e. Sind and Rajputana including Gujarat, Kutch and portions of Central India.

c/o Faiz & Co.,
75, Abdul Rehman Street,
Bombay,
February 15, 1952.

HUMAYUN ABDULALI

21. OCCURRENCE OF THE PHEASANT-TAILED JAÇANA (*HYDROPHASIANUS CHIRURGUS* SCOP.) IN NELLORE DISTRICT, MADRAS

In Volume 50, No. 2, of the *Journal* the editors publish a note remarking on the occurrence of the Pheasant-tailed Jacana in Madras. I therefore list the following recording as being of some interest:—

On March 25, at 3.30 p.m., whilst watching birds on the semi-dry reservoir at Sarvepalli (80'0" East by 14'20" North) a village on the Venkatachalamchatram-Krishnapatnam road, south of Nellore town, my wading through the shallow water, choked with a heavy growing weed, disturbed a flock of some twenty to twenty-four Pheasant-tailed Jaçana. The flock flew at my approach and settled again some twenty yards away, watching me with suspicion but allowing me to draw within some five yards of them.

Most of the birds were in the winter plumage, but at least six were in transitional plumage and three in almost complete summer dress except for the tail feathers.

Other birds noted on the tank that afternoon were Brahminy Kites, Pariah Kites, a solitary Lagger which stooped at a flock of Little Ringed Plover, several small flocks of Little Stint, a group of five Blackwinged Stilt, Egrets, Indian Wiskered Terns, Wiretailed Swallows and Palm Swifts. Also a single Redwattled Lapwing.

C/O POSTMASTER,
GUDUR, NELLORE, K. M. KIRKPATRICK
April 11, 1952.

22. BIRDS ATTACKING THEIR REFLECTIONS

In previous issues of the *Journal* I have read correspondence about Jungle Babblers attacking the shining hub caps and other chromium parts of motor cars (and have frequently observed this myself in Delhi). During the last few weeks I have been watching an Eastern Grey Wagtail (*Motacilla cinerea caspica*) regularly attacking the hub caps of a small car parked in a busy Calcutta compound. The bird would flit against the hub cap pecking sharply at the surface. It would often repeat this action on all the hub caps in turn. The only sound it uttered was if it was disturbed and flew away. It appeared always to be alone. Water standing in a nearby drain provided the only faint reminder of a wagtail's preferred natural habitat. The delicate tapping noise became a familiar sound in the quiet of the early mornings or during the hot afternoons.

20, RAJA SANTOSH ROAD,
ALIPORE,
CALCUTTA, (MRS.) MARGARET RIVERS
April 8, 1952.

[We have also observed this propensity in a wagtail of the same species in Bombay. With the help of a shaving mirror and horse-hair nooses spread around it on a lawn, the bird was captured for ringing purposes. It escaped while being handled, but so great was the attraction of the mirror that the bird returned to the attack in less than five minutes and this time was successfully ringed. By means of the ring it was recognized as the identical individual that appropriated this particular patch of lawn during 6 successive seasons. It was observed that the fighting instinct was present only on first arrival in September each year and then quickly wore off. It may be due to territorial jealousy of a supposed rival for the feeding ground.—EDS.]

23. BIRD MIGRATION IN INDIA

Since publishing the last record in Vol. 50, p. 177, the following information has been received concerning one more recovery of a Russian ringed bird, through the good offices of the Embassy of India in Moscow :—

No. of ring	Date	Name of bird	Place where ringed	Remarks (adult or young)	Name of ringer	Date of recovery	Reported by	Place where recovered	Remarks
MOSKWA/ 108672E	20-7-1949	Garganey Teal (*Anas querquedula*)	The lake in Mikhalov region, Pavlograd Oblast, Kazakh Soviet Socialist Republic 80 kilometers to the west of railway station Kupino (54° 30′ N × 76° 10′ E)	Female	Central Bird Banding Bureau, Moscow	25-2-1951	A. St. J. Macdonald	Shot by Mr. Antony of the O. T. Railway in Ujiarpur jheel approximately 7 miles south of Samastipur, Darbhanga District, North Bihar (25° N × 86°E).	

114, APOLLO STREET, FORT,

BOMBAY, *March* 6, 1952

EDITORS

24. LARGE STONE IN STOMACH OF CROCODILE

I am sending you a fairly large stone weighing 5 lb. 8 oz. (220 tolas) which was found in the empty stomach of a 10 ft.-3 ins. crocodile I recently shot at Jasdan.

Though pebbles, small stones and other hard substances are commonly found in the maws of crocodiles I have never so far found such a large stone though I have examined over a hundred stomachs.

DIL BAHAR,
BHAVNAGAR, K. S. DHARMAKUMARSINHJI
January 21, 1952.

[As has been remarked by the editors previously (Vol. 30, 703) the stones and pebbles are presumably swallowed as an aid to digestion, but we cannot trace any record of one as large as this taken from a crocodile before.—EDS.]

25. LOCALIZATION OF THE STRIPED VARIETY OF THE ROUGHTAILED EARTHSNAKE—*UROPELTIS MACROLEPIS* (PETERS)—TO MAHABLESHWAR

An earth-snake recently collected at Mahableshwar (4,000 ft., Western Ghats) agrees with *Uropeltis macrolepis* (Peters) except that the sub-caudals are 13 in number instead of 7 to 10 (Malcolm Smith's Fauna, Vol. III, p. 79) though Wall in 'The Handlist of the Snakes of the Indian Empire' refers to specimens between Lonavli (lat. 18° 70′) and Igatpuri (lat. 19° 70′) and records the sub-caudals as 7 to 12. The Fauna also refers to a specimen which agrees with the one from Mahableshwar in the presence of a brownish yellow stripe (extending to 3 scale rows) along each flank throughout the length of the body, as compared with a broken line of spots in others.

12 specimens have been examined, 9 in the Society's collections from Lonavla, Khandala, Igatpuri and Matheran—and without locality—and 3 from Khandala in the St. Xavier's College collection. All of them have 10 sub-caudals, and none the unbroken stripe on the sides.

At Dr. Malcolm Smith's suggestion the striped variety is hereby localized to Mahableshwar.

Mr. Humayun Abdulali who obtained this specimen states that it was caught alive, placed in a cardboard box and left in the boot of his car for a few hours and then found dead. In life it had a bright red tongue.

Mr. McCann (*J.B.N.H.S.*, 29, 1062, and *in episola*) also obtained several specimens at Mahableshwar, but these are not now traceable.

The overall length of the specimen—head to tip of tail—is 250 mm. (in spirit).

Lepidosis

I. *Costals.*	
1. Two headlengths behind the head	15
2. Mid-body	15
3. Two headlengths before the vent	15
II. *Ventrals*	121
III. *Anal* divided.	
IV. *Sub-Caudals*	13

Bombay,
December 17, 1951.

V. K. CHARI
Assistant Curator

26. APOSEMATIC BUTTERFLIES PROTECTED BY THE POISONOUS QUALITIES OF THEIR LARVAL FOOD-PLANTS

With reference to Mr. Wynter Blyth's remarks on this subject (1951, *Journ., Bomb. Nat. Hist. Soc.*, **50**, 354), the late professor Poulton commented on this hypothesis, originally propounded by Haase, before the Entomological Society of London in 1916.

The late Professor stated that the hypothesis did not satisfy him and that whilst he thought it possible (but never definitely proved) that the distasteful and poisonous properties of the food plant might be utilised by the larva and retained in the imago, it was also possible for the insect itself to produce distasteful or poisonous juices in the laboratory of its own body.

He went on to say that whilst, amongst the examples quoted by Haase, the Danaidae feeding on Asclepiads and the *Pharmacophagus* (now *Polydorus*) Swallowtails feeding on Aristolochias were probably cases of the utilisation of this ready-made protection, the Heliconinae were not as the Passifloraceae, their food-plants, had been said to be without any poisonous properties by Dr. O. Stapf, F.R.S. A number of Acraeidae feed on Passifloraceae in the larval stage, and this is another well-protected group. Dr. Stapf was also quoted as saying that the Loranthaceae, the food-plants of *Delias* and *Mylothris*, had no acrid or poisonous qualities.

A little thought will bring to mind many examples of both poisonous and non-poisonous plants that are the common food-plant of the larvae of both aposematic and procryptic species, I use the term here with reference to the imago. A few examples will suffice. Oleander is eaten by *Euploea* (Danaidae and protected) and *Agathia* (Goemetridae and procryptic) and by *Deilephila nerii* (Sphingidae and procryptic). *Loranthus* spp. by *Delias* and *Mylothris* (both aposematic Pieridae), by several Lycaenids and by a number of procryptic Geometers. Castor by *Pericallia ricini* (aposematic Arctiidae) and by numerous procryptic Noctuidae and Geometridae. Strangely enough, although the Passifloraceae is stated to be non-poisonous, the three main groups feeding on it—the American Heliconines, the Oriental *Cethosia* and the Acraeidae—are all well-known aposematic groups and form, in many cases, the centre of both Batesian and Mullerian mimetic associations.

KAMPALA,
March 3, 1952.

D. G. SEVASTOPULO, F.R.E.S.

27. NOTES ON THE LEPIDOPTERA OF ASSAM—I

1. LARVAL AND PUPAL STAGES OF *Eriboea arja* FELDER.

I found three nearly fully grown larvae feeding on wild saplings of Sau (*Albizzia* sp.) during October, in thick jungle at plains level. These hatched into 2 ♂♂ and 1 ♀, the latter taking from 23rd October until 2nd November in the pupal stage. A fourth larva, found on Sau in a cultivated area, was heavily parasitised by a small Hymenopteron.

Comouflage is so remarkably good that in the first case, when I saw a Sau sapling completely stripped of leaflets excepting two terminal areas of an inch or so, it was some seconds before I realised that these areas were, in fact, larvae.

The head of the larva is broad and flat, dark green, and with darker green longitudinal stripes. An inner and an outer pair of horns project backwards from the posterior part of the head, which is edged with orange between the horns. The outer horns are about half the length of the inner ones, are slightly and evenly curved, and each bears 6 downward projecting yellow combs. The inner horns each have 2 curves, and are tipped with black. The ground colour of the body is bluish green, the legs yellow. The first 11 segments bear half moons of light green, convex backwards, and edged with yellow and then black, this edging being most marked on the convexity. There is a yellow dot above each of the legs (but not the first pair) and claspers. A yellow lateral streak is interrupted from the first to the ninth segment of the body, and thereafter continuous. On each of the first 9 segments this streak consists of 2 yellow dashes going obliquely upwards and backwards to end just in front of the horn of the half moon.

Though the larva conforms to the usual Eriboeid shape, I am not prepared to conform to tradition and describe this as 'slug like'.

The pupa is of the usual Eriboeid shape, squat and smooth. The ground colour is pale green, with 2 broad milky-white dorsal raphae, and another lateral one above the spiracles. The wing cases are milky, with 3 oblique pale green raphae.

The cremasteric apparatus consists of a projecting spine (2 mm.) attached to the pupa by a brown plaque on which, at each side, are 3 pale brown knobs, the size and shape of raspberry pips.

2. LARVAL AND PUPAL STAGES OF *Cirrochroa aoris aoris* DOUBLEDAY.

Two fully grown larvae were found, in early November, on the under surfaces of the leaves of secondary growth from the stump of a large tree in 'jhumed' forest. It was not possible to identify the food-plant from such insufficient data.

The head of the larva is pale yellow and shiny, and has 2 pairs of black spots. The ground colour of the body is pale yellow, with a row of dark brown spots down the back. On each side there are 3 rows of spines, each spine being 5 mm. long, and bearing lateral hairs. As the length of the fully grown larva itself is only 25 mm. the spines appear to be out of all proportion to its size. The spines of the lowest row, 9 in number, arise from a series of tubercles of the ground colour, the spines being somewhat paler. The second row, 11 in number, are black, with the middle 2 mm. of the half dozen central ones coloured white. The third row has 12 black spines, and both this and the previous row arise from a series of black tubercles. The legs are dark and light banded, and the suckers are of the ground colour.

The pupa is large for the size of the larva. The head is moderately bifid, ending in 2 points, and with 2 ventrolaterally projecting spines. The ground colour is white, with a conspicuous black marking in the centre of each wing cover. The abdomen is acutely flexed, with a row of dark markings down the ventral surface. The spiracles are yellowish; dorsal to them is a row of reddish black markings, and a similar row is placed mid-dorsally. The pupa bears the following bristles: a pair on the dorsal hump and another pair just behind this, 2 rows of 8 bristles each on the dorsal surface of the abdomen, and 2 lateral pairs on each side of the apex of the wing cases. These pupal bristles are dark at the tip and reddish ochre at the base.

3. A FURTHER OCCURRENCE OF *Prothoe franckii regalis* BUTLER.

The capture of a very old and worn specimen of this exceedingly rare species in the forest bordering the Naga Hills in Sibsagar District, on 2-12-1951, seems worth recording. Though there must be others, I can only find 4 previous records. These are:—

(*a*) The type specimen from Manipur.
(*b*) Another from 'Sadiya, near Margharita, in Upper Assam' mentioned in Seitz's monumental work.
(*c*) Two caught by Mr. C. B. Antram at Loharband in Cachar, on the Lushai border, June 1912.

All specimens so far recorded have been males.

SELENG T. E.,
SELENG HAT P.O.,
UPPER ASSAM,
January 5, 1952.

T. NORMAN

28. MATURE LARVA OF *PALES TOWNSENDI* BARANOFF (DIPTERA: TACHINIDAE)

(*With a plate*)

A dull mature larva of *Phytometra orichalcea* Fabricius (Lepidoptera: Noctuidae) was captured on 3rd March, 1949, on *Litsaea polyantha* at New Forest, Dehra Dun, harbouring maggots of *Pales* *townsendi* Baranoff. On 4th March, 3 maggots came out by rupturing the skin of the host. Two maggots were preserved for study and one was allowed to pupate. The tachinid fly emerged on 14th March after a puparial period of 10 days. Its puparium is described by Gardner in the *Indian Forest Records*, **6** (7); 246, 1940.

Mature maggot (Fig. A) Dull-white, opaque, containing a large amount of fat. Size variable, measuring from 9.5 mm. to 11.0 mm. in length and 3.0 mm. to 4.2 mm. wide, broadest across the ninth segment and tapering gradually toward the anterior end, and bluntly at the posterior extremity. Cuticle colourless, armed with minute sharp spines (Fig. D) arranged in small lineal groups.

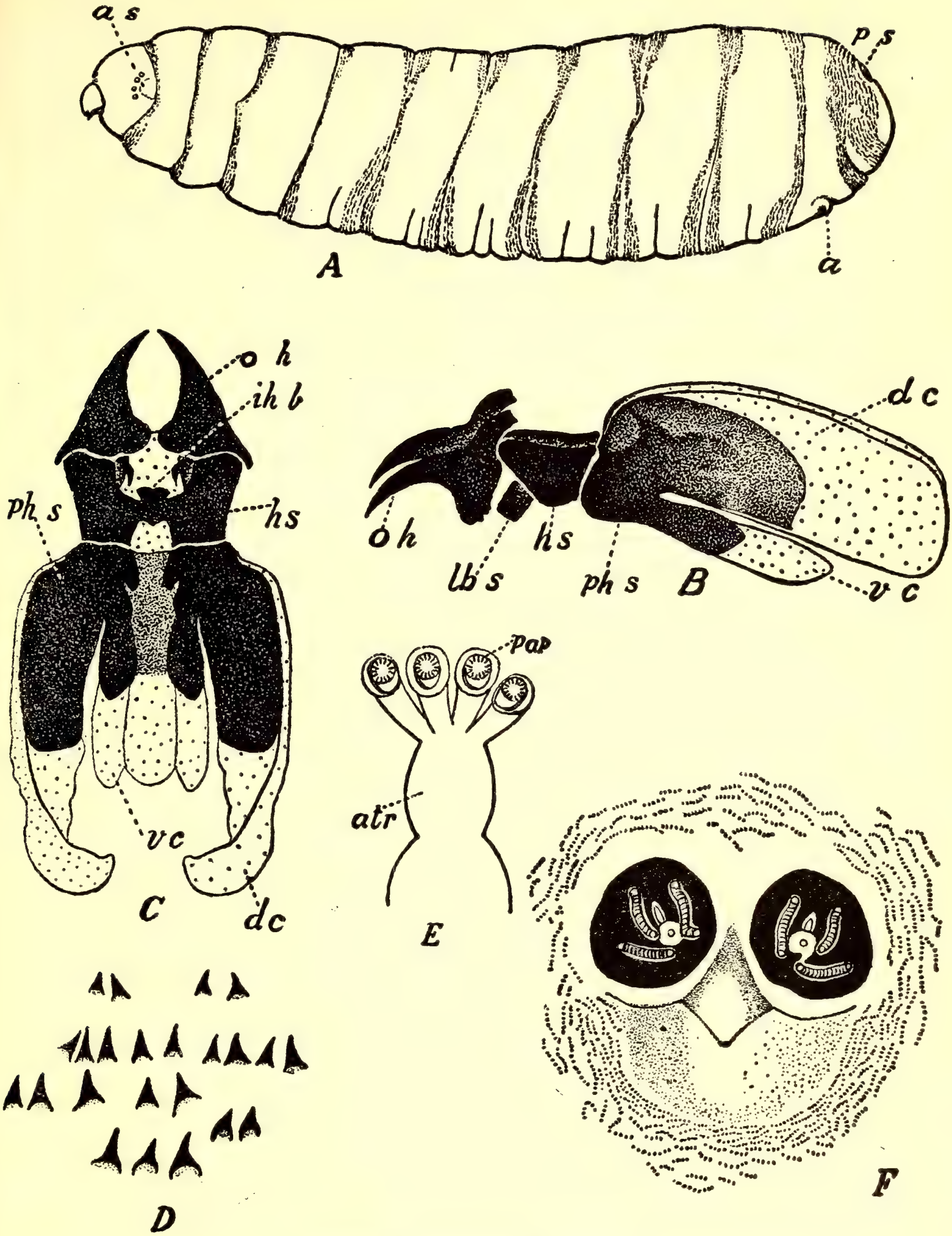
Pseudocephalon unarmed, bearing two pairs of large, prominent sensory organs. Segments 1 to 4 with anterior bands of spines, segments 5 to 9 with both anterior and posterior bands of spines. Spines present on the dorsal aspect of segments 4 to 9 finer than of the ventral side. Spines in the lateral region greatly less and more finer. Ventral spines on the anterior border of segments 6 to 10 plentiful, while on the posterior borders they become less numerous. On segment 10 the band on the posterior border is complete and moderately thick throughout. Segment 11 bears the posterior spiracles on its upper caudal aspect. Spiracles are completely encircled by curved lineal groups of spines. Spines on the anterior borders of segments point backward, while those on the posterior margins point forward. Spines of segment 11 point outward. On each side, near the posterior margin of segment 4, a small round pit is present, probably tactile in function. Anal opening (*a*) is situated mid-ventrally on tenth segment, having a transverse cleft.

Buccopharyngeal armature (Figs. B, C) well developed and about 0.75 mm. long. It consists of a pair of deeply curved anterior or oral hooks (*o h*) which are broad basally and articulate dorsally with the hypostomal sclerites. Hypostomal sclerites (*h s*) are joined ventrally by the infrahypostomal bridge (*ih b*) and articulate posteriorly with the pharyngeal sclerites (*ph s*). Lying free below the posterior margin of the anterior hooks, are two very small labial sclerites (*lb s*) which support the labium. Pharyngeal sclerites consist of two dorsal cornua (*d c*) and a fused ventral cornu (*v c*).

Anterior spiracles (Fig. E) (*a s*) are located near the posterior border of segment 1 in the pleural region, each containing four respiratory papillae (*pap*). Each papilla with a silt-like aperture opening posteriorly into a wide atrium (*atr*) connecting the tracheal tube. Posterior spiracles (Fig. 1 F) (*p s*) are surrounded by the highly sclerotized black peritremes and open on the dorsopleural portion of eleventh segment. Peritremes slightly longer than wide, and separated by less than half the width of one of them. Each spiracle consists of three slits, having the upper and middle slits nearly vertical and the lower slit horizontal. Button prominent, circular and away from the centre.

DEHRA DUN,
June 15, 1952.

R. N. MATHUR, M.SC., Ph.D., F.E.S.I.,
Systematic Entomologist,
Forest Research Institute.



PALES TOWNSENDI Baranoff

A, lateral view of mature larva; *B*, lateral view of cephalopharyngeal sclerites; *C*, dorsal view of same; *D*, cuticular spines; *E*, anterior spiracle; *F*, posterior view of larva, showing posterior spiracles. *a*, anus; *a s*, anterior spiracle; *atr*, atrium; *d c*, dorsal cornu; *h s*, hypostomal sclerites; *i h b*, infrahypostomal bridge; *l b s*, labial sclerites; *o h*, oral hooks; *pap*, respiratory papillae; *ph s*, pharyngeal sclerites; *p s*, posterior spiracles; *v c*. ventral cornu.

29. PROBABLE ODOUR TRAILS IN TERMITES (ISOPTERA)

In January last I happened to collect a part of a carton nest of *Microcerotermes heimi* with a large number of living individuals (workers, soldiers and nymphs) in it, and kept it in the laboratory on a slab of stone. It was noticed, after a few hours, that the termites started coming out of the nest and wandered about on the slab in different directions. It was left like this overnight and next morning it was seen that the termites were moving on a definite trail between the nest and a hole in the wooden frame of a nearby window. Some individuals were going away from the nest while others were returning back to it. They kept rigidly to the track thus established and the whole scene looked very much as in the typical ants (Formicinae). Some obstructions (a piece of chalk or stone etc.) were put across the track and it was found that these confused the termites and deflected them in various directions at the place of obstruction. In trying to get round the obstacle they almost completely lost their way unless they accidently struck the trail again when the file was resumed. If they retouched the track on this side of the obstruction they followed it mechanically back to the starting point; if by chance on the other side of the obstacle then the journey was completed. Similar disorganisation took place when the track was rubbed out with a finger tip at some point.

UNIVERSITY OF DELHI, H. S. VISHNOI
DELHI, 8. *Lecturer in Zoology*
April 3, 1952.

[According to T. E. Snyder (1935), 'Our Enemy the Termite', p. 51, body odour, as well as contact stimuli, aid blind worker and soldier termites to maintain a single file formation outside of the main nest. This can be observed by watching termites under an upturned log or stone. Either one or the other of these stimuli, or possibly both, enables termites to run a straight course to a source of food and might account for other activities, sometimes grouped under the heading of the mysterious 'spirit of the colony'.—EDS.]

30. ON THE OCCURRENCE OF THE FRESHWATER MEDUSA IN THE KRISHNARAJASAGAR ON THE CAUVERY

In a recent note regarding the distribution of the Indian freshwater medusa, *Limnocnida indica* Annandale, in the April 1951 issue of this *Journal* (**49**, 799-801) Jones pointed out the present range of its distribution and stated that a systematic survey of the distribution of the medusa and a study of its life-history should yield interesting results. In this connection it may be of interest to record here the occurrence of the freshwater medusa, in the Krishnarajasagar Reservoir on the Cauvery River in Mysore.

While collecting fish specimens in the morning (between 7 a.m. and 9 a.m.) on 27-4-1949, on the right bank of the Reservoir near the village of Sagarkatte about 7 miles above the dam and below the confluence of the Laxmanthirtha River, one of the tributaries of the Cauvery, the disturbance caused by the cast-net brought up several medusa, presumably *Limnocnida indica* Annandale, to the surface. They were seen bobbing up and down in the turbid water and about half a dozen specimens were collected which were subsequently handed over to Shri M. S. R. Rao of the Zoological Department, Science College, Mysore. The depth of water at the place of collection was about 5 feet and the bed was rocky. About a week previously there were a few showers but the weather on the above date was bright.

The presence of the freshwater medusa in the Krishnarajasagar extends its distribution on the western side of the Sahyadris, from the Krishna to the Cauvery system. On the western slopes of the Sahyadris it is known from the Periyar and the Sharavati Rivers. The medusa in all probability has a wider distribution than hitherto recorded both on the eastern as well as western drainages of peninsular India.

BARRACKPORE, D. R. KRISHNAMURTHY, B.SC.
October 30, 1951.

[This medusa had so far been recorded only from the Krishna drainage. Dr. S. Jones, D.SC., in communicating the above note expresses the opinion that its occurrence in the Cauvery system, which is *south* of the Krishna system, is of significant zoogeographical interest since it extends its distribution in peninsular India so much further southward. Its apparent absence north of the Krishna drainage seems curious. He thinks that the occurrence of freshwater medusa also in Africa provides an instance of the sort of discontinuous distribution that might lend support to the view of the existence of a former land connection between Africa and peninsular India. Dr. Jones points out that practically nothing is so far known about the life-history of this remarkable organism.—EDS.]

31. NOTES ON THE GENUS *LUDWIGIA* LINN.

THE NUMBER OF STAMENS

The separation of the two genera, *Jussiaea* Linn. and *Ludwigia* Linn., apparently rests mainly on the (supposed) difference in the number of stamens. According to authoritative works, the number of stamens in each genus is stated to be: *Jussiaea* 8 and *Ludwigia* 4. Members of both genera are very similar, not only in habit but also in habitat. When making field sketches of the floral details of *L. parviflora* Roxb. I noticed that between the bases of the four stamens there were four scars. These naturally aroused my curiosity. On checking up with the literature, I found I was correct with regard to the number of stamens I had depicted, four, but I could not account for the four scars—they suggested that something had fallen away. I went back to the field and examined numerous freshly opened flowers; all had four stamens and four scars. I took some of the plants home and kept them under close observation, paying particular attention to the time of opening. On examining flowers that were just about to open, I noticed that each one had eight stamens, and a little later on, four and four scars. Here then was the clue—four stamens are caducous on opening. The examination of buds only confirmed my previous observations; there were eight stamens to each flower. Further observation in the field indicated that four of the eight anthers matured and dehisced at the time of opening, but by the time the flowers opened fully, they dropped. Such curious behaviour probably has some relation to the mode of pollination, for the remaining four anthers mature only after the maturation of the stigma. Such behaviour suggest a provision for both cross- and self-pollination by visiting insects. Fruit is abundantly produced by the species. Under the circumstances I feel that the two genera should be united.

Let me turn now to some other aspects of *L. parviflora*. Although, usually a small herb of from a few inches to two feet, it not uncommonly attains twice that height. When growing in very boggy situations, especially near water of some depth, it will often produce long, thick, white, spongy roots which often float at the surface of the water. It seems possible that these roots may serve as aerating organs, but only further study will provide the proof.

The floral parts are normally tetramerous, but slight deviations may occur under abnormal circumstances. The petals and stamens are particularly fragile and fall readily. The eight stamens are arranged in two groups, 4 long and 4 short; a few hairs are to be found at the base of the filaments. The stamens are *very readily* detached, even in fresh flowers. Arising from the centre of the disc is the pistil which overtops the longest anthers, slightly. The stigma is obpyriform with a shallow depression above. The pollen grains are round, minutely spinulose and operculate.

The beetle *Haltica cyanea* is a common pest of this species, feeding largely on the leaves and occasionally covering the plants in great numbers. This beetle appears to be partial to many aquatic plants, particularly *Ammania* and *Rotala*.

DOMINION MUSEUM,
WELLINGTON,
NEW ZEALAND,
January 15, 1952.

CHARLES McCANN, F.L.S.

[The separation of the two genera, *Jussiaea* and *Ludwigia*, seems to have been based on defective observation and may have to be modified. McCann has noted his observations on *Ludwigia*; one of us (H.S.) has written on the subject of *Jussiaea*: 'Stamens variable in number; on April 13th, 1946, I examined 16 flowers and counted their floral parts: all had 4 sepals, 4 petals; as for the stamens, 1 flower had only 4, 2 had 5, 6 had 7, 7 had 8; all these flowers came from only two plants, and in most cases unopened buds were selected for these counts.' In all the cases where the number of stamens was less than 8, there was no scar visible to show that some of the missing stamens could have fallen off. It is clear, therefore, that at least sometimes, *Jussiaea* has fewer than 8 stamens, and *Ludwigia* has more than 4. Further details on the subject will be welcome.—EDS.]

32. LONGEVITY OF SUCCULENTS IN HERBARIA

Referring to Mr. Natarajan's note on this subject, published in the *Journal* (Vol. 49, p. 134) and the Editorial comment, I would like to add a few remarks.

The longevity of improperly killed specimens in herbaria is not an uncommon occurrence, and is well-known to most botanists who have built up an herbarium. Members of the Portulacaceae, Chenopodiaceae, Euphorbiaceae, Liliaceae, Araceae, and a few other orders are particularly troublesome if not properly killed before pressing. On this account I adopted the method of either soaking or painting most of my specimens in or with a concentrated solution of corrosive sublimate in alcohol before consigning them to the press. If necessary, the treatment was repeated when changing papers. This proved the most effective method, and what is more, it also fixed the leaflets of such species which usually disintigrate in the process of preservation—*Acacia, Cassia* and their ilk. Even the otherwise troublesome Loranthaceae respond well to this treatment.

The reference by the Editors to the longevity of an *Euphorbia* and its 'ill treatment' by me needs some clarification as the plant submitted to boiling was in fact *Commiphora mukul* Engl. Before erecting the original Desert Case in the Prince of Wales Museum, I went to Sind and collected all the material there, and among the specimens was a small bush of the species in question. After some months in the workshop, the plant did not show any signs of drying, so, in an effort to hasten its death, I decided to boil it. Not having a pot big enough to take the whole specimen, I submerged the cut end in the vessel and boiled it for several hours. Deeming this sufficient, I left it. To my great surprise, the next morning when I arrived at the office, I found that the plant had sent out new shoots! It was again subjected to boiling, and to cut a long story short, it produced fresh leaves and flowers! However, it did die in the end, and was in the case in the Museum when I left in 1947.

Euphorbia: Specimens of *Euphorbia neriifolia* and *E. ligularia* I have known to survive for several months on a shelf, but the prize for longevity certainly goes to the tuberous species, *E. khandalensis*. I have kept tubers of this species for several years on a shelf, and they annually produced an anaemic crop of leaves and flowers at each season.

A few other records will not be out of place:

Sauromatum guttatum Scht.: Some years ago I collected a corm in flower; it was at the time about three and a half inches across. After it flowered it produced a leaf during the monsoon. The following February it flowered again, and then leafed during the monsoon. After each leaf a new and smaller corm was formed. After this the corm produced a leaf each monsoon, but never flowered again. Both the corm and leaf became smaller each year, till finally, when I threw it out after eight years, the corm was no bigger than a small marble. It must be pointed out that the leaf became smaller and smaller and very anaemic, and more often than not did not unfold.

Urginea indica Kunth: In 1932 I collected a number of these bulbs and kept them on a shelf. The first two or three years they produced leaves and flowering scapes; then for another couple of years flowering scapes only. After this the bulbs gradually decreased in size annually, and were still alive when I threw them out in 1947. When the bulbs were obtained they were healthy specimens, some measuring about an inch and a half in diameter, and when I disposed of them 15 years later they were no longer than a 'scale' of garlic!

I have known many of the Liliaceous plants to survive several years in the herbarium—i.e. the bulbs. Likewise species of *Aerides*, *Dendrobium* and some other epiphytes.

DOMINION MUSEUM, C. McCANN
WELLINGTON,
NEW ZEALAND,
July 10, 1952.

33. WILD LIFE PRESERVATION

SOME LESSONS FROM AFRICA AND ELSEWHERE

In the *Journal of the Fauna Preservation Society*, 'Oryx', Vol. 1, No. 5, April 1952, are Notes and Reports which contain lessons for India.

The Kruger National Park. Editorial Notes, p. 216:—

'Annual grass burning has been part of the ecology of vast areas of Africa, including that of the Kruger National Park, from time immemorial and has been one of the factors which has given rise to the wonderful array of wild animals which live there. If it is now stopped there is little doubt that a marked change in the fauna will take place.'

It would seem that just now there is too much theorizing by experts in Government offices, who have ordained that there shall be no grass burning, because grass burning constitutes interference with nature, and upon the lack of control in the numbers of carnivores, especially lions. 'Probably the larger antelope which dislike long grass will leave the park' . . . . The carnivores did not prevent the rapid increase in the numbers of antelope when the park was first formed. Why should they now suddenly cause a great decrease?'

The above is pertinent to India for there are already two opinions in this country in regard to management of National Parks. One is that management should include ordinary forest operations, while the other would have the parks left entirely to nature to work out the destiny of the fauna and flora without human interference.

West Africa. 'There can be no doubt that in recent years baboons and other monkeys have enormously increased in West Africa. Among the reasons given for this . . . is the increased killing of leopards and other cats for their skins.'

In India also the balance of nature in this respect is being disturbed through too much destruction of the tigers and panthers in the reserved and other forests.

Arabia. 'But the last decade has witnessed the advent of a shocking predator, namely the "Mighty Jeep". It cannot be long now before motorized hunting parties will sweep Arabia's fauna into uttermost corners, where a subsequent drought will whiten its bones.'

This same predator and its many motor-car relatives are at work in many parts of India. The Excise Law provides for the confiscation by convicting magistrates of motor vehicles used to contravene the excise laws and rules. The game laws should do the same.

'In Arabia the Ostrich is extinct. These birds existed in some numbers in North-Western Saudi Arabia until about twenty years ago. Then during the 1930's there was a big massacre in order to obtain plumes, but a few survivors lingered on until about 1944 when the last were killed.' (Desmond Foster-Vesey-Fitzgerald.)

In India the Great Indian Bustard is being rapidly reduced to the vanishing point by the trappers and snarers and the next decade may well see final extermination of the species. The birds are conspicuous, and only one egg is laid.

Jamaica. 'Another factor leading to the depletion of bird life is the small, sometimes not so small, boy with his slingshot or catapult. The importation of catapult elastic has been prohibited for many years but unfortunately strips of old inner tubes serve the same purpose. The handling of this menace is entirely in the hands of parents and teachers.'

The writer relates that in an area where caterpillars were destroying crops it happened that every small boy was armed with a catapult.

'A few years ago most of our inland waters were in danger of losing all their fishy inhabitants, thanks to uncontrolled netting, dynamiting and poisoning.'

'As a result of this (cited) protection and propaganda work, the stock of fish in most of our rivers is once more on the increase.'

(E. W. March, Conservator of Forests.)

Kenya. 'Only in national parks is there any certainty of permanent wild life conservation. . . . In the reserves the demands of man override the requirements of nature and will gradually absorb them. The parks within their present boundaries are insufficient alone to preserve even a typical remnant of Kenya's game.'

(Royal National Parks of Kenya. Report 1946-50. C.L.B.)

BANGALORE,
May 1, 1952.

R. W. BURTON
Lt.-Col., I.A. (Retd.).

NOTES & NEWS

The Central Wild Life Board

A press note dated New Delhi, April 11, 1952, announced as follows:

'To preserve the fauna of India, prevent the extinction of any species and preserve wild life, the Government of India has appointed a Central Board for Wild Life.

The Rajpramukh of Mysore will be Chairman of the Board, and Sri K. S. Dharmakumarsinhji of Bhavnagar and the Inspector-General of Forests, its Vice-Chairmen.

Other members of the Board will be a representative each of the Geological Survey of India, the Zoological Survey of India, the Botanical Survey of India, the Bombay Natural History Society, the Bengal Natural History Society, the National Institute of Sciences, the Natural Resources and Scientific Research Ministry, the Transport Ministry, State Forest Departments, State Zoological Gardens and Fisheries Development Adviser.

An officer of the Central Food and Agriculture Ministry will be the Board's Secretary.

The functions of the Board will include devising ways and means of conservation and control of wild life through coordinated legislative and practical measures with particular reference to seasonal and regional closures, and declaration of certain species of animals as protected animals, and prevention of indiscriminate killing;

Sponsoring and setting up of national parks, sanctuaries and zoological gardens;

Promoting public interest in wild life and the need for its preservation in harmony with natural and human environment;

Advising the Government on policy in respect of export of living animals, trophies, skins, furs, feathers and other wild life products; and

Preventing cruelty to birds and beasts caught alive, with or without injury.'

This step by the Government of India is a momentous and important one. It should have far-reaching and lasting results.

* * * *

What they think of the Wild Life Calendar for 1952

Without comment:

Letter No. 1

'At long last I received my 12 copies of the so called "Wild Life" Calendar last night, and I am *most* disappointed and astounded at the subjects chosen to illustrate it. Surely, you could have done better than this. To those who know India, as well as those who do not, Indian "Wild Life" conjures up pictures of the Tiger, Leopard, Elephant, the magnificent Bull Gaur and Barasingha, the wild mountain sheep and goat tribes—*none* of which have been given a place in the calendar—not—*repeat not*—scorpions, robber crabs, Praying Mantis and *Common swallows*! Most of the latter may be classified as "Domesticated" since found in the houses in towns, etc! Further, since from the cover page this calendar is apparently meant to be a mild form of propaganda for the preservation of wild life, nobody is really interested in the preservation of vermin such as the scorpion!!! But everybody interested in wild life *is* keen to see adequate steps taken to preserve all Game animals and other wild life which are not vermin.

The photograph of the "Indian Wild Ass" may easily be that of the village dhobi's donkey off on a spree! to those who do not know the animal. Of what earthly use is a black and white photograph of the Sunbird wherein its marvellous colours are not shown?

With such books like Champion's "The Jungle in Sunlight and Shadow" etc. available, there can be no excuse made that good photographs of Tiger; Leopard; Elephant; Gaur etc. could not be obtained. Even a picture of a Tiger taken in a Zoo would have been better than that of the scorpion. What surprises me is that the common field rat and bandicoot were not given a place in the calendar! Ye Gods and little fishes!!!

Had I only known how you proposed to illustrate the calendar, I would not have wasted my money in placing my order. As it stands, I do not consider that it is worth the paper it is printed on or the expense of postage to my friends. I can well imagine my friends abroad, especially in Africa, exclaiming "is this all they can show us of wild life in India?" *WHAT a flop*!

If you would be prepared to print this letter in the next issue of the *Journal* it would be interesting to read the views of other members on the subject.'

Letter No. 2

'. . . . In my opinion and that of my many friends it is the best which has appeared for many years. The photos are excellent and the lighter type used for the dates harmonises better with the illustrations than did the heavier type previously in use. The only comment I have is that the name of our Society is omitted at the bottom of each page—it would serve as a good advertisement.'

Letter No. 3

'. . . . I have had warm praises from those I sent them to. I certainly think they are very good in spite of the absence of tiger or panther which everyone seems to expect in any publication dealing with India.'

Letter No. 4

'. . . . I congratulate you on the excellent calendars that you have produced.'

* * * *

To commemorate the Silver Jubilee of the first contribution to science made by that doyen of Indian zoologists, Dr. Sunder Lal Hora, and as a mark of their appreciation of the long and meritorious services he has rendered, particularly in the cause of ichthyology and fisheries research in India, his numerous pupils, admirers and friends decided to publish a souvenir. Happily this has taken the form of a brochure entitled 'Bibliography of the Publications of Sunder Lal Hora'.

Hora's name enjoys a unique distinction among contemporary Indian scientists, and his researches and achievements in many fields, especially in ichthyology, have won him international fame. The bibliography lists all the papers published by him each year between 1920 and 1950, aggregating to the imposing total of 337. The majority of them deal with fishes and fisheries and for a student of Indian ichthyology these references are indispensable.

Copies of the Bibliography can be obtained from the Honorary Secretary, Bombay Natural History Society, on request. The price fixed by the Silver Jubilee Committee is Rs. 4 per copy.

* * * *

NATURAL HISTORY AWARD

At a meeting of the Society's Executive Committee held on 3rd July 1951, it was decided to revive the scheme of the Natural History Award which had lapsed for some time due to lack of suitable response. A grant of Rs. 600 is being set aside every year to be awarded to one or more students, preferably between the ages of 18 and 25 years interested in the pursuit of some specific piece of *field* work in any branch of botany or zoology, the purpose being to encourage field work among students. A circular to this effect was sent out last year to all science colleges in Bombay State and 7 applications were received.

A sub-committee consisting of the Honorary Secretary, Rev. Fr. H. Santapau and Dr. S. B. Setna was formed to scrutinize the applications and make the selection. Two candidates were finally awarded the grant of Rs. 300 each for the year 1952, payable in 3 instalments of Rs. 100 each every 4 months.

The recipients are Miss A. J. Randeria, B.SC., of St. Xavier's College, Bombay, working on the Monopetalous Phanerogams of the Krishnagiri National Park at Borivli, and Mr. M. K. Thakur of the Institute of Science, Bombay, who has the ecology and bionomics of Arachnid animals (spiders, etc.) as his subject.

The conditions of the grant are that students submit reports of their work to the Society every 4 months and that on completion, their results be first offered to the Society for publication in the *Journal*.

* * * *

FORTHCOMING SCIENTIFIC EXPEDITION

Our latest Vice-Patron, Mr. W. T. Loke of Singapore, has generously offered to finance an ornithological expedition to Sikkim in the coming winter to carry out a comprehensive bird survey and study the life conditions of high altitude Himalayan birds. It will be led by Mr. Sálim Ali and is to be known as 'The Loke-Sálim Ali Sikkim Expedition'. Field work is expected to commence in late November. The Sikkim State authorities have kindly agreed to cooperate by extending the necessary facilities to the expedition.

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Contributors of scientific articles are requested to assist the editors by observing the following instructions :

1. Papers which have at the same time been offered for publication to other journals or periodicals, or have already been published elsewhere, should not be submitted.

2. The MS should preferably be typed (double spacing) on one side of a sheet only, and the sheets properly numbered.

3. All scientific names, to be printed in italics, should be underlined. Both in zoological and in botanical references only the initial letter of the genus is capitalized. The specific and sub-specific names always begin with a small letter even if they refer to a person or a place, e.g. *Anthus hodgsoni hodgsoni* or *Streptopelia chinensis suratensis* or *Dimeria blatteri*.

4. Trinomials referring to subspecies should only be used where identification has been authentically established by comparison of specimens actually collected. In all other cases, or where identification is based merely on sight, binomials should be used.

5. Photographs for reproduction must be clear and show good contrast. Prints must be of a size not smaller than 3¼ × 2¼ inches (No. 2 Brownie) and on glossy glazed paper.

6. Text figures, line drawings and maps should be in Indian ink, preferably on Bristol board.

7. References to literature should be placed at the end of the paper, alphabetically arranged under author's name with the abridged titles of journals or periodicals underlined (italics), and titles of books *not* underlined (roman type), thus ;

Roepke, W. (1949) ; The Genus Nyctemera Hübner. *Trans. ent. Soc. Lond.*, **100** (2) ; 47-70.

Prater, S. H. (1948) ; The Book of Indian Animals, Bombay.

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8. Reference to literature in the text should be made by quoting the author's name and year of publication, thus ; (Roepke, 1949).

9. *Synopsis* : As recommended by the Royal Society Scientific Information Conference (July 1948), the editors consider it desirable that each scientific paper be accompanied by a synopsis appearing at the beginning, immediately after the title. The synopsis should be factual. It should convey briefly the content of the paper ; draw attention to all new information and to the author's main conclusions. It should also indicate newly observed facts, the method and conclusions of an experiment, and if possible the essential points of any new finding, theory or technique. It should be concise and normally not exceed 200 words.

When the synopsis is complete it should be carefully revised by the author to clarify obscurities, and further compressed wherever possible without detracting from its usefulness.

114 Apollo Street, Fort,
Bombay 1.

EDITORS,
Journal of the Bombay Natural
History Society.

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